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HIGH HAZARD LOCATION STUDY

FOR

YELLOWSTONE COUNTY, MONTANA

DCA PROJECT NO. 79-04-01-01

Prepared By:

HKM ASSOCIATES
P.O. BOX 31318
Airport Industrial Park
Billings, Montana 59107

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April 30, 1979

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Mr. Harlan M. Lund
Yellowstone County Surveyor
Yellowstone County Courthouse
Billings, Montana 59101

Re: DCA Project No. 79-04-01-01
Yellowstone County High Hazard Location Study

Dear Mr. Lund:

We are pleased to submit this report concerning the study of high hazard locations in Yellowstone County. This report conforms to our agreement with Yellowstone County dated December 26, 1978.

The report includes a recommended program for continued evaluation of hazardous locations in the County. Recommendations to reduce the hazardous conditions at twenty locations studied are also presented.

We appreciate the opportunity to be of service to the County and gratefully acknowledge the coopration of your office and the Montana Department of Community Affairs.

Sincerely,

HKM ASSOCIATES

Norman K. Gutcher

Norman K. Gutcher, P.E.
Director, Transportation Division

NKG:so

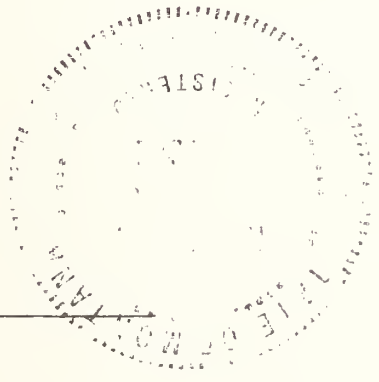
Enclosure

HIGH HAZARD LOCATION STUDY

FOR

YELLOWSTONE COUNTY, MONTANA

DCA PROJECT NO. 79-04-01-01



Norman K. Gutcher, P.E.


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HIGH HAZARD LOCATION STUDY
FOR
YELLOWSTONE COUNTY, MONTANA

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Accident Summary Form
Priority Index Determination Form
Condition Diagram
Accident Diagram
Recommended Improvement Diagram

A. INTRODUCTION

HIGH HAZARD LOCATION STUDY
YELLOWSTONE COUNTY, MONTANA
DCA PROJECT NO. 79-04-01-01

A. INTRODUCTION

The purpose of this report is to present a recommended program for evaluation of hazardous locations on the road system of Yellowstone County. Twenty locations selected by the County have been analyzed using this evaluation program. Recommendations to reduce the hazardous conditions at these locations are also presented in this report.

A preliminary evaluation program was developed using Report No. FHWA-RD-77-82 "Identification of Hazardous Locations" as a guide. This preliminary evaluation program was used initially to evaluate the twenty locations. Modifications to the program were then tested to develop a cost effective evaluation program which would be responsive to conditions in Yellowstone County.

The recommended evaluation program is intended to provide a cost-effective method for continued identification and analysis of hazardous locations throughout the County road system.

B. SUMMARY AND RECOMMENDATIONS

B. SUMMARY AND RECOMMENDATIONS

Based on the evaluation of twenty locations in Yellowstone County, a recommended evaluation program for identification of hazardous locations has been developed. It is recommended that locations in the County be evaluated using four parameters: Number of Accidents, Accident Rate, Accident Severity, and Cost of Improvement.

Several other parameters were considered for inclusion in this evaluation program: Volume/Capacity Ratio, Sight Distance, Driver Expectancy, and Information System Deficiencies. Since these parameters demand a great amount of time for data collection and analysis, require considerable field work, and do not significantly affect the relative hazardous ratings of the locations studied, we felt they were not cost-effective for the County program. These parameters were therefore eliminated. The procedure used to develop the recommended evaluation program is presented in detail in Section C of this report.

The recommended evaluation program is used to develop a Hazard Index using Number of Accidents, Accident Rate, and Accident Severity Indicators. A Cost Factor is then determined which is a function of the cost of the recommended treatment for a location and of the traffic volume at that location. Finally a weighted average of the Hazard Index and Cost Factor are used to develop a Priority Index. The recommended evaluation program is presented in detail in Section D of this report.

The twenty locations selected by the County have been evaluated using the recommended program. The results of this analysis are summarized in Table 1. The locations are listed in order of priority using the Priority Index.

TABLE 1

YELLOWSTONE COUNTY, MONTANA
HIGH HAZARD LOCATION STUDY
PRIORITY LIST

Priority	Location No. and Description	Priority Index	Hazard Index	Cost Factor	Recommended Treatment	Estimated Cost
1	16 - 3rd St. in Worden	79.0	71.95	100	Signing & Pavement, Markings for Parallel Parking	$1,000.00
2	7 - Curve on Old Chicago Rd.	75.7	67.55	100	Upgrading Signing	$150.00
3	18 - Lake Elmo at Pemberton Lane	71.5	62.98	97	Removal of Trees & Brush, Signing, Delineation	$610.00
4	14 - Curve on Garden Ave. South of	65.0	53.31	100	Update Signing, Remove Brush, Delineation	$400.00
5	1 - Curve West of Shiloh Rd. Overpass	63.2	57.98	79	Reconstruct Curve	$48,100.00
6	5 - Grand Ave. at 54th St. West	62.5	55.34	84	Upgrade Signing, Striping	$450.00
7	4 - Bench Blvd. at Entrance to Coulsen Park	61.6	48.84	100	Signing and Delineation	$200.00

Continued

TABLE 1
(Continued)

Priority	Location No. and Description	Priority Index	Hazard Index	Cost Factor	Recommended Treatment	Estimated Cost
8	17 - 32nd Street West just North of King Ave.	60.0	46.71	100	Signing at Bridge	$60.00
9	12 - Curve on Road to Billings Landfill	58.8	46.14	97	Upgrade Signing, Removal of Trees and Brush, Delineation	$3,500.00
10	2 - Old Hardin Rd. and Dickie Rd. (Curve)	57.6	73.50	10	Reconstruct Curve	$119,400.0
11	3 - Bench Blvd. at Anchor St.	57.0	42.72	100	Remove Trees & Brush, Upgrade Signing	$790.00
12	20 - Curves on Yellowstone River Rd. at County Nursing Home	50.6	49.52	54	Reconstruct Curve	$60,840.00
13	19 - Bench Blvd. at Yellowstone River Rd. and Conway St.	48.5	35.34	88	Reconstruct Intersection	$48,100.00
14	15 - Curve On Yellowstone River Rd. East of Bench Blvd.	44.1	35.10	71	Reconstruct Curve	$52,000.00

Continued

TABLE 1
(Continued)

Priority	Location No. and Description	Priority Index	Hazard Index	Cost Factor	Recommended Treatment	Estimated Cost
15	6 - Bench Blvd. from Steffanich to Birch St.	N/A	62.24	---	No Action	----
16	8 - McGirl Rd.	N/A	42.45	---	No Action	----
17	10 - Lockwood Rd. at Refinery Rd.	N/A	39.72	---	No Action	----
18	11 - Wicks Lane at Bench Blvd.	N/A	37.62	---	No Action	----
19	9 - Old Hardin Rd. at Piccolo Lane	N/A	33.62	---	No Action	----
20	13 - Old Hardin Rd. at Greenwood Ave.	N/A	29.84	---	No Action	----

Source: HKM Associates

The Hazard Index, Cost Factor, and the nature of the recommended treatment for each location are also shown. A detailed evaluation of each location is presented in Section E. Accident summary sheets, priority index data sheets, condition diagrams, accident diagrams, and recommended treatment diagrams, if applicable, are included for each location.

The effectiveness of an evaluation program for identification of hazardous locations is dependent on the data used in the evaluation. Good accident records must be maintained to identify potentially hazardous locations. In the past the State Highway Patrol has investigated all accidents on the County road system and filed accident reports. These accident records have been well maintained by the State Highway Department.

Yellowstone County has been advised that the State Highway Patrol may soon limit their accident investigations to the State highway system. Should this occur, it is essential that the County Sheriff's Department be prepared to investigate accidents on the County road system. This may require additional men and equipment.

To be effectively used, accident records should always be identified by a simple system. Yellowstone County has established a system of route numbers and mile posts. This system must be used for accident reporting if proper records are to be maintained in usable form.

County officials should make an annual review of accident records to identify hazardous locations for evaluation. For Yellowstone County, an average of 1.5 accidents per year over a three year period is recommended as the criteria to identify potentially hazardous locations.

The Montana Department of Highways can provide a print out of accidents by location. Approximately March 15 of each year the County should request a list of all accidents outside incorporated areas showing four or more accidents over the previous three years.

Traffic volume data is equally important for the evaluation of hazardousness. It is essential that Yellowstone County officials work to establish and maintain an ongoing County wide traffic count program. This should include and expand on the efforts of the City-County Planning Board. The traffic count program should, at a minimum, cover all the urbanized areas of the County once every three years. Other locations in the County can be counted if they appear to be hazardous.

C. EVALUATION PROCEDURE

C. EVALUATION PROCEDURE

This section of the report outlines the procedure used to analyze the selected locations and to develop the recommended evaluation program for Yellowstone County. The following twenty locations were selected by the County for evaluation:

1. The connection of MDOH Construction with the old county road just west of the north end of Shiloh Road overpass.

2. The connection of Old Hardin Road with Dickie Road

3. The Intersection of Bench Blvd. and Anchor Street

4. Bench Blvd. - at entrance of Coulson Park

5. Intersection of Grand Ave. with 54th Street W.

6. Bench Blvd. - Section between Steffanich and Birch Lane

7. Curve on Old Chicago Road just north of U.S. 312

8. McGirl Road just east of U.S. 312

9. Intersection of Piccolo Lane and Old Hardin Road

10. Intersection of Refinery Road with Lockwood Road

11. Intersection of Wicks Lane and Bench Blvd.

12. Curve on road to City dump just west of Blue Creek Road.

13. Intersection of Greenwood Avenue and Old Hardin Road

14. Garden Avenue - First sharp curve south of 27th

15. Yellowstone River Road - curve above Coulson Park just east of Bench Blvd.

16. 3rd Street in Worden

17. 32nd Street West just north of King Avenue

18. Intersection of Pemberton Lane & Lake Elmo Drive

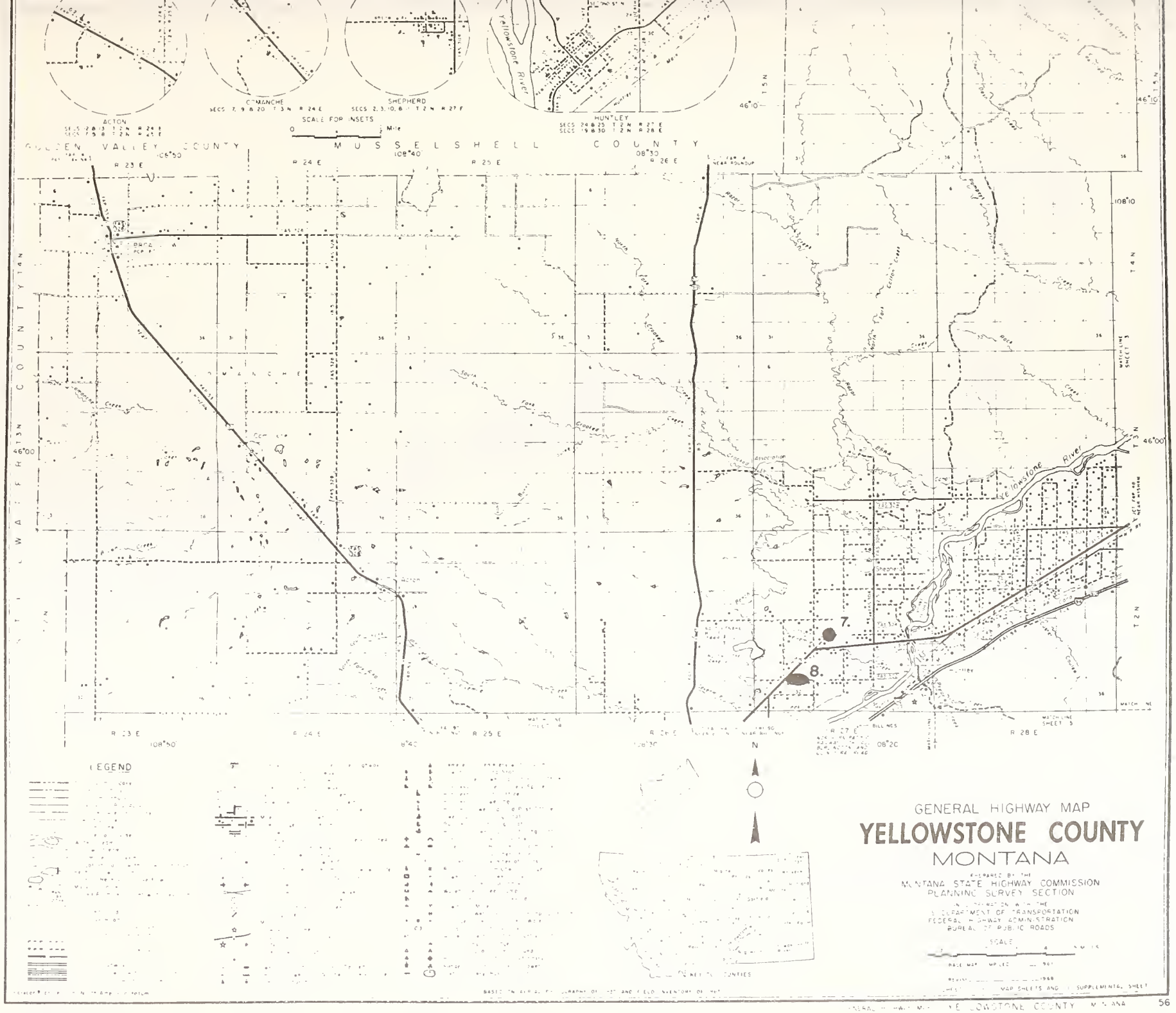
19. Intersection of Conway and Yellowstone River Road with Bench Blvd.

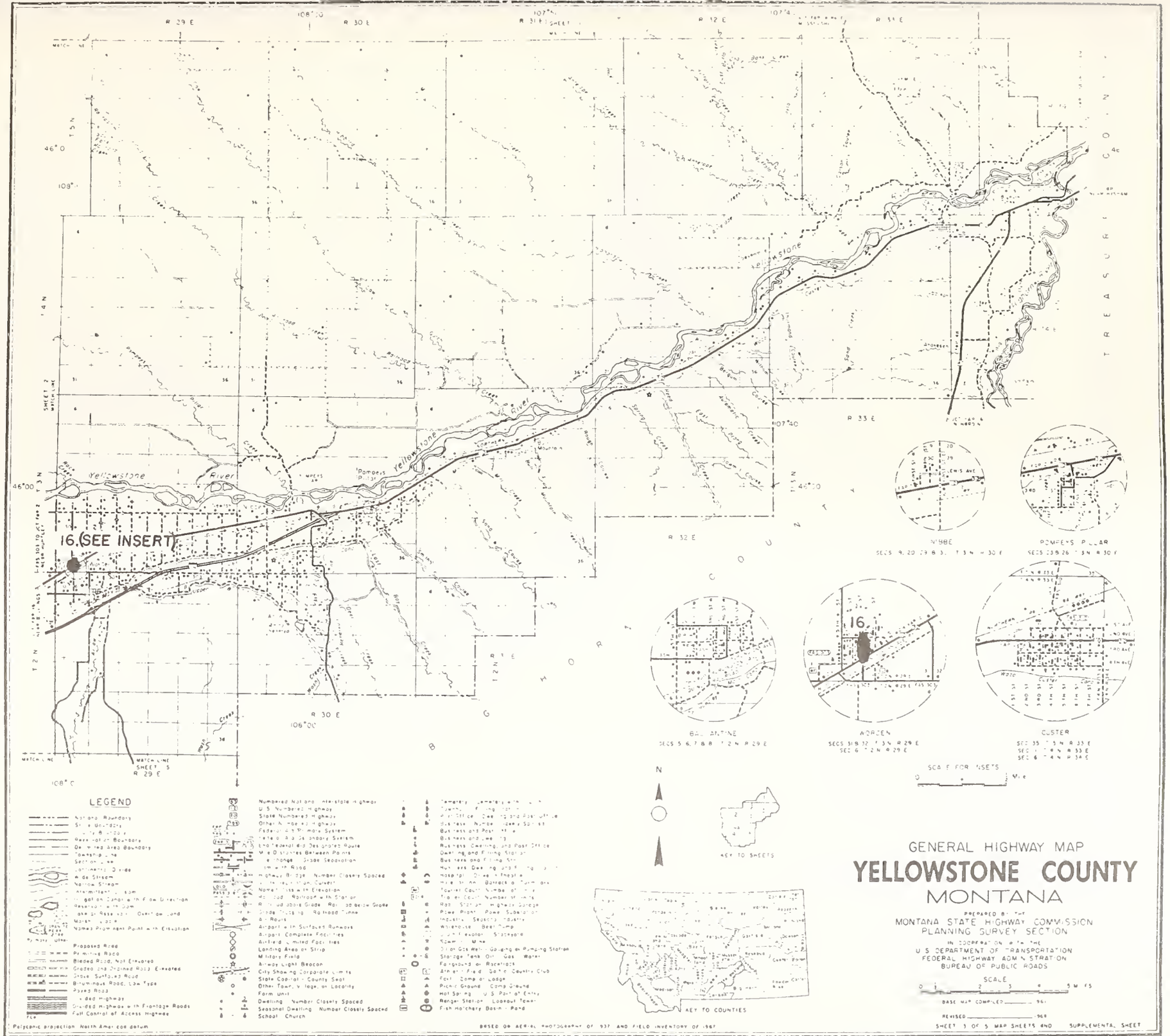
20. Yellowstone River Road "S" curve by County Nursing Home

A map is provided on Plates 1 through 4 to assist the reader in identifying these locations.

The initial step in the evaluation of the accident locations was to collect and review all available data. Copies of accident reports for the 1974 through 1976 study period were collected from the Montana Department of Highways offices in Helena. Available sign inventory data were collected from the Yellowstone County Surveyor's office. Traffic volume information for several locations was collected from the Montana Department of Highways and the Billings City-County Planning Department.

Information regarding the physical layout of the locations to be studied was not available and was obtained through field surveys. Manual traffic counts were made where


GENERAL HIGHWAY MAP
YELLOWSTONE COUNTY
MONTANA
PREPARED BY THE
MONTANA STATE HIGHWAY COMMISSION
PLANNING SURVEY SECTION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
LEGEND
SCALE FOR INSETS
ACTON
COMANCHE
SHEPHERD
HUNTLEY
GOLDEN VALLEY COUNTY
MUSSELSHELL COUNTY
YELLOWSTONE COUNTY
Yellowstone River
Billings
Shepherd
Huntley
Acton
Broadview
Lavina
Roundup
Melstone
Ryegate
Harlowton
Two Leggins
Big Coulee
Big Ditch
Big Timber
Reed Point
Absarokee
Fromberg
Bridger
Joliet
Columbus
Park City
Laurel
Billings
Shepherd
Huntley
Worden
Ballantine
Pompeys Pillar
Custer
Hysham
Forsyth
Rosebud
Miles City
Baker
Plevna
Circle
Jordan
Glendive
Sidney
Fairview
Wibaux
Terry
Fallon
Baker
Ekalaka
Broadus
Alzada
Camp Crook
Buffalo
Sheridan
Ranchester
Dayton
Parkman
Story
Big Horn
Wyola
Lodge Grass
Crow Agency
Hardin
Pryor
Warren
Edgar
Bridger
Joliet
Columbus
Park City
Laurel
Billings
Shepherd
Huntley
Worden
Ballantine
Pompeys Pillar
Custer
Hysham
Forsyth
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Camp Crook
Buffalo
Sheridan
Ranchester
Dayton
Parkman
Story
Big Horn
Wyola
Lodge Grass
Crow Agency
Hardin
Pryor
Warren
Edgar



GENERAL HIGHWAY MAP

YELLOWSTONE COUNTY

MONTANA

PREPARED BY THE
MONTANA STATE HIGHWAY COMMISSION
PLANNING SURVEY SECTION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

SCALE
0 1 2 3 4 5 MILES

BASE MAP COMPILED ____ 196-
REVISED ____ 196-
SHEET 1 OF 5 MAP SHEETS AND SUPPLEMENTAL SHEET

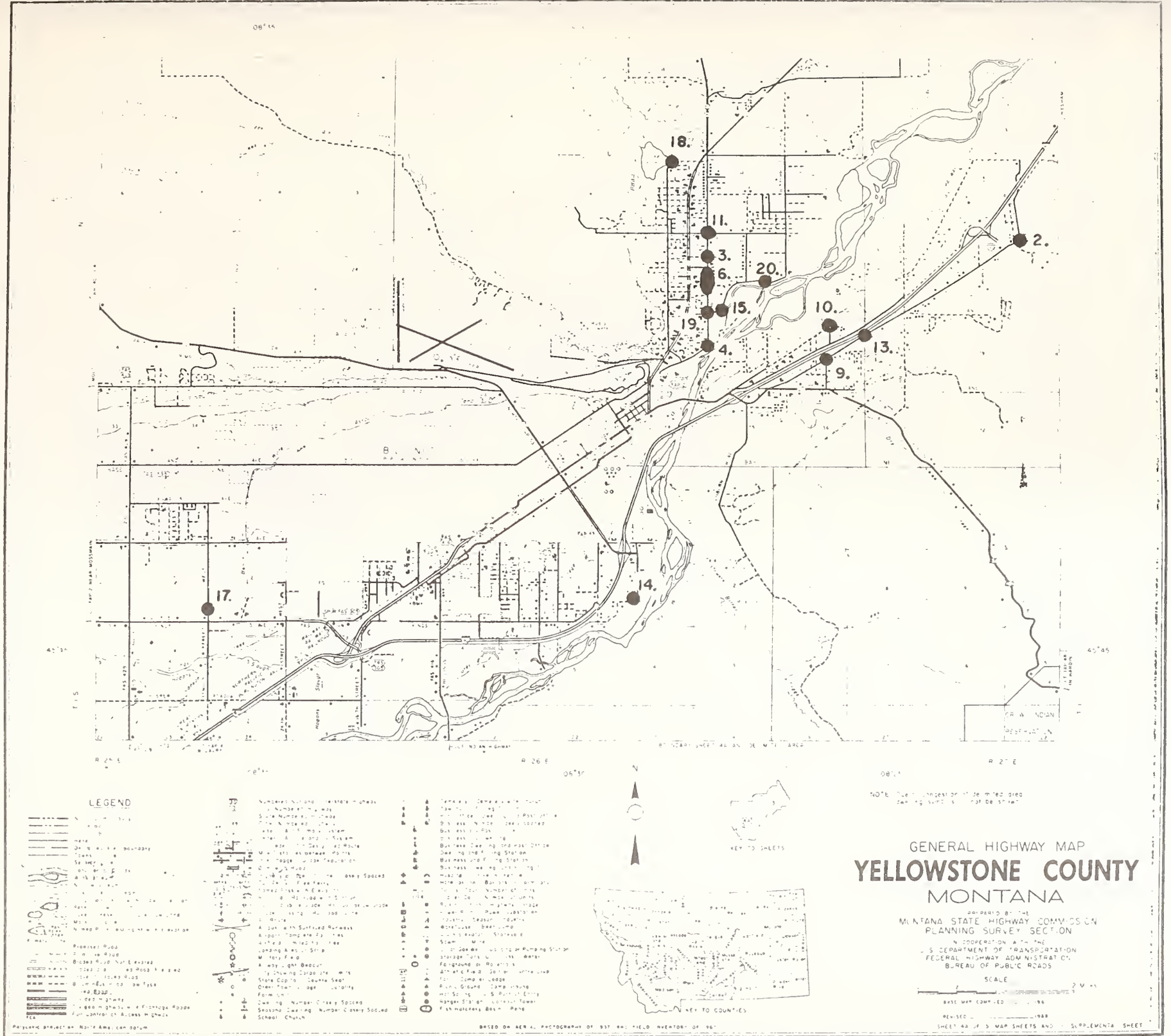

18.
11.
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14.
LEGEND
KEY TO SHEETS
KEY TO COUNTIES
GENERAL HIGHWAY MAP
YELLOWSTONE COUNTY
MONTANA
MONTANA STATE HIGHWAY COMMISSION
PLANNING SURVEY SECTION
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
SCALE

Plate 3

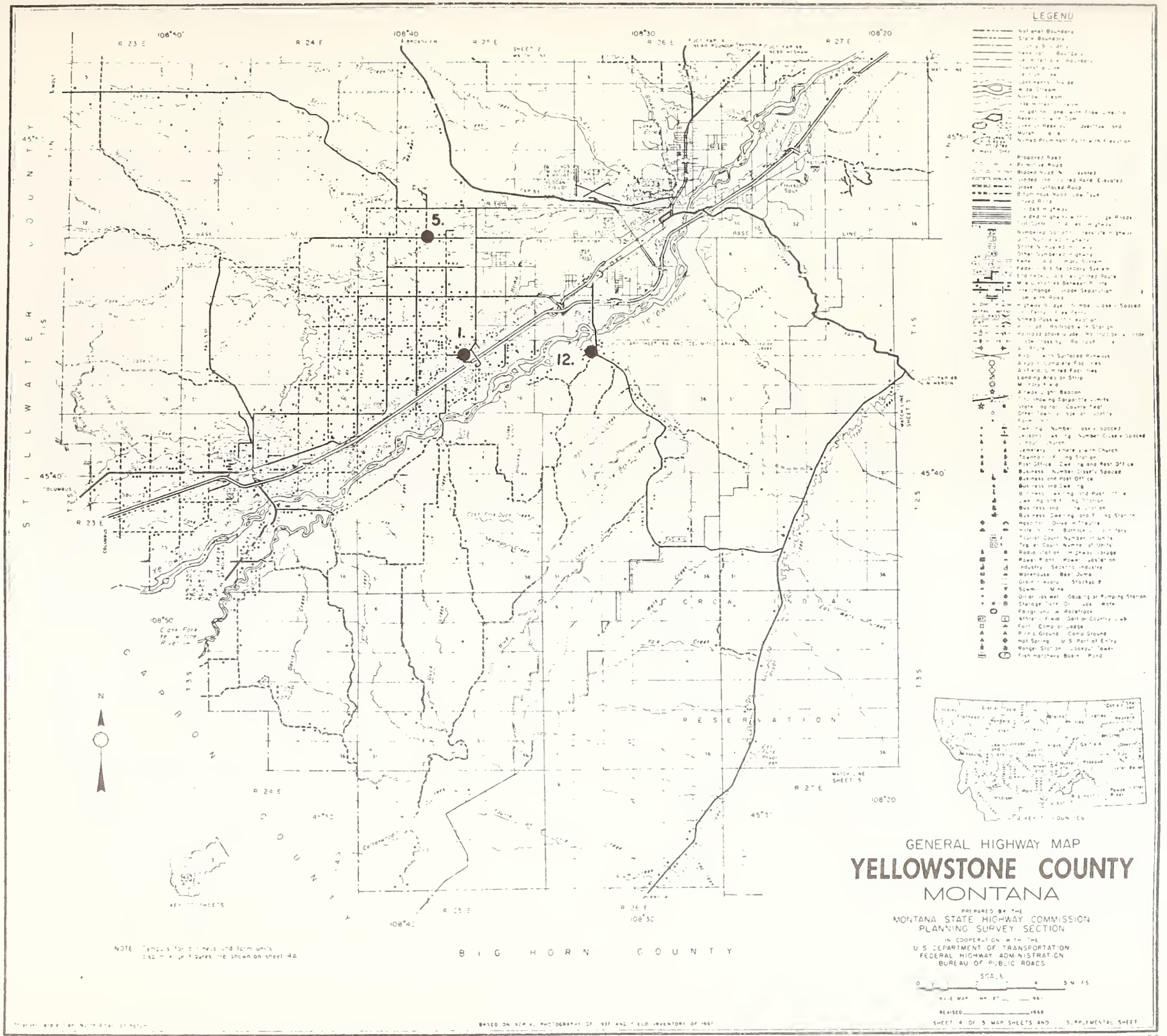

LEGEND
GENERAL HIGHWAY MAP
YELLOWSTONE COUNTY
MONTANA
PREPARED BY THE
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IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
SCALE
BASED ON AERIAL PHOTOGRAPHY OF 1937 AND FIELD INVENTORY OF 1960
SHEET 4 OF 5 MAP SHEETS AND 1 SUPPLEMENTAL SHEET
STILLWATER COUNTY
BIG HORN COUNTY
CROW RESERVATION
1.
5.
12.

Plate 4

existing counts were not available. Traffic was counted for one hour periods and then expanded into average daily traffic volumes at these locations. This was accomplished using hourly and monthly traffic variation factors obtained from the City of Billings Traffic Department. Charts showing the hourly and monthly variations in traffic volume are shown on Figures 1 and 2.

A preliminary evaluation program was developed for use in analyzing the hazardousness of each of the twenty locations selected by the County. This preliminary program was approved by the County Surveyor's Office on February 7, 1979.

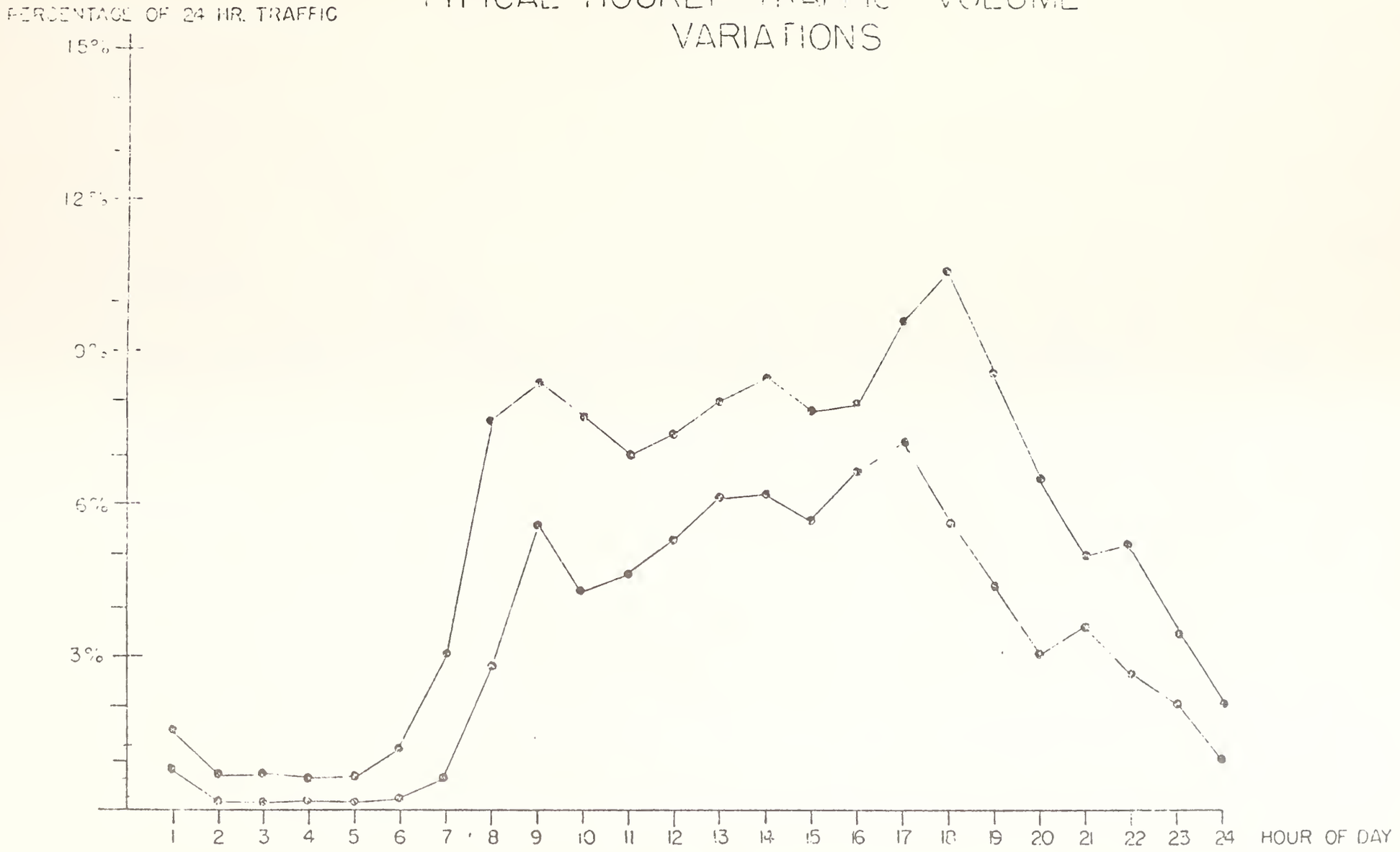
Each location was evaluated for hazardousness using the following seven parameters or indicators:

1. Number of Accidents
2. Accident Rate
3. Accident Severity
4. Volume/Capacity Ratio
5. Sight Distance
6. Driver Expectancy
7. Information System Deficiencies

The data initially collected were used to develop indicator values for Indicators 1 through 5. To determine indicator values for the Driver Expectancy and Information System Deficiencies indicators, it was necessary to rate each location using guidelines defined in the preliminary evaluation program. Each location was visited and rated by a three member team. The team was comprised of non-technical people because the ratings were intended to reflect an average driver's perception of these parameters.

CITY OF BILLINGS

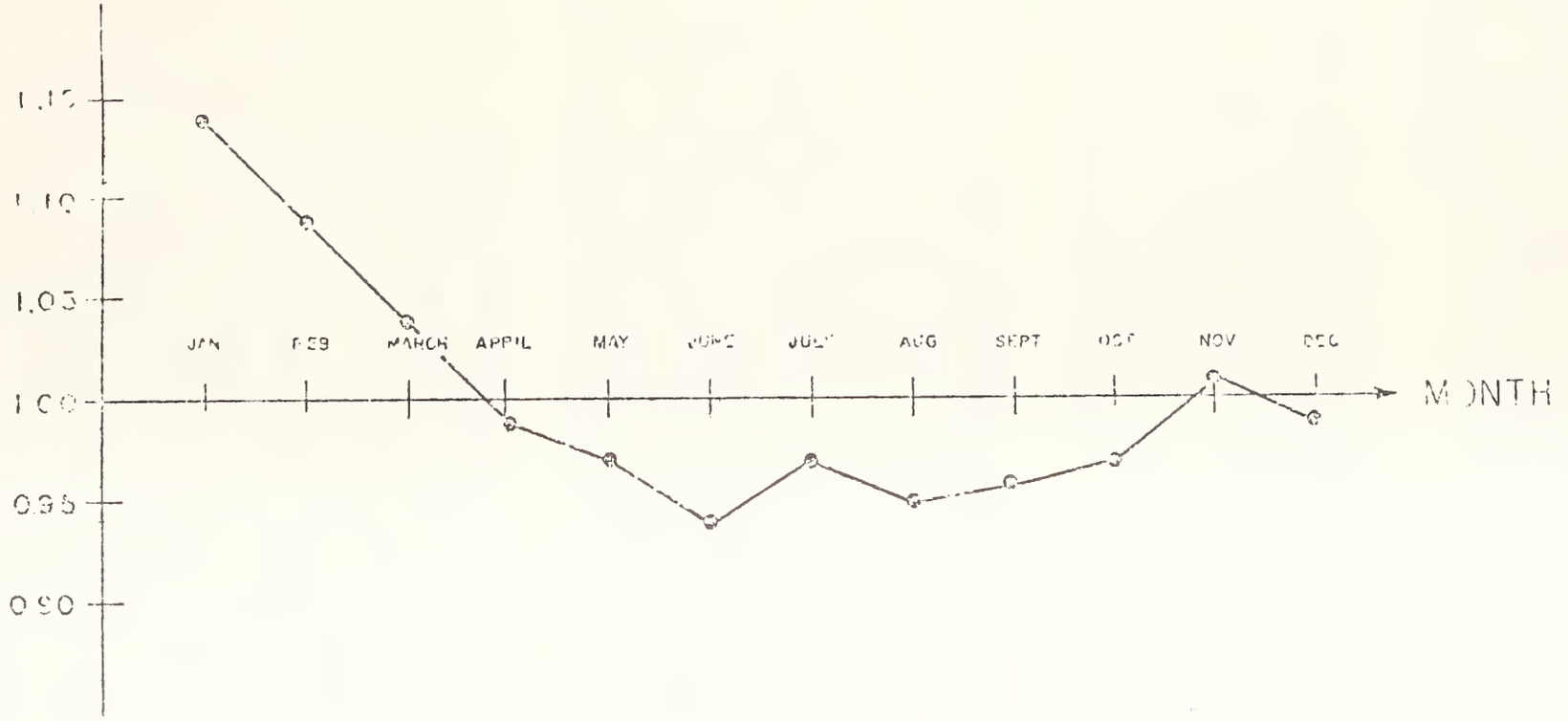
TYPICAL HOURLY TRAFFIC VOLUME VARIATIONS



Source: City of Billings

Figure 1

MONTHLY TRAFFIC VOLUME VARIATION CORRECTION FACTORS



SOURCE: PERMANENT TRAFFIC COUNT STATION ON GRAND AVENUE BY 12TH ST. W.

(DATA OF 1974 - 1975 - 1976)

Source: City of Billings

FIGURE 1

Figure 2

Since some of the indicators are stronger than others, a weighted average of the indicator values was used to determine a Hazard Index. The Hazard Index values range from 0 to 100 with the larger values indicating a higher degree of hazardousness.

Each location was then studied to determine what improvements should be made to reduce the hazardousness of that site. The type of improvements recommended are based on the existing geometrics of the location, sight distance restrictions, existing signing, accident occurrence, and traffic volumes and speeds.

Preliminary cost estimates were developed for the improvements at each location. Using projected traffic volumes for a five year period, the cost per vehicle entering a location was determined. A five year period was selected as a reasonable design life for a project involving new signing. Use of a longer period would tend to overemphasize those locations where the recommended treatment involves only new signing. Based on the cost per vehicle, a Cost Factor was obtained for each location.

The next step in the evaluation of the hazardous locations was to develop a Priority Index for each location. The Priority Index is a weighted average of the Hazard Index and the Cost Factor. Initially the Hazard Index was weighted 0.75 and the Cost Factor was weighted 0.25. A high Priority Index indicates a location has a high benefit/cost ratio. Completed Priority Index determination forms used for the preliminary evaluation can be found in the Appendix. A priority list was prepared by ranking the locations from highest Priority Index to lowest Priority Index. The priority list developed from this initial evaluation is shown on Table 2.

TABLE 2

YELLOWSTONE COUNTY HIGH HAZARD LOCATION STUDY
PRIORITY LIST BASED ON INITIAL EVALUATION

Priority	Location No. and Description	Hazard Index	Cost Factor	Priority Index
1	16 - 3rd St. in Worden	60.09	100	70.1
2	7 - Curve on Old Chicago Rd.	56.17	100	67.1
3	18 - Lake Elmo at Pemberton Lane	49.74	97	61.6
4	12 - Curve on Road to Billings Landfill	47.08	97	59.6
5	5 - Grand Ave. at 54th St. West	50.79	84	59.1
6	14 - Curve on Garden Ave. South of 27th St.	44.75	100	58.6
7	4 - Bench Blvd. at Entrance to Coulsen Park	43.48	100	57.6
8	3 - Bench Blvd. at Anchor St.	42.19	100	56.6
9	1 - Curve West of Shiloh Rd. Overpass	44.64	79	53.2
10	17 - 32nd St. West just North of King Ave.	36.70	100	52.5

Continued

TABLE 2
(Continued)

Priority	Location No. and Description	Hazard Index	Cost Factor	Priority Index
11	19 - Bench Blvd. at Yellowstone River Rd. and Conway St.	36.49	88	49.4
12	2 - Old Hardin Rd. and Dickie Rd. (Curve)	62.32	10	49.2
13	20 - Curves on Yellowstone River Rd. at County Nursing Home	44.47	54	46.9
14	15 - Curve on Yellowstone River Rd. East of Bench Blvd.	35.40	71	44.3
15	6 - Bench Blvd. from Steffanich to Birch St.	46.84	---	---
16	8 - McGirl Rd.	38.37	---	---
17	11 - Wicks Lane at Bench Blvd.	32.01	---	---
18	10 - Lockwood Rd. at Refinery Rd.	31.81	---	---
19	9 - Old Hardin Rd. at Piccolo Lane	25.40	---	---
20	13 - Old Hardin Rd. at Greenwood Ave.	24.40	---	---

After completion of the initial evaluation of the twenty locations, possible modifications to the evaluation program were studied. To establish the sensitivity of each indicator a new Hazard Index was determined for each location eliminating one indicator at a time. The results of this analysis are shown on Table 3.

Four of the indicators do not significantly affect the ranking of the locations according to hazardousness when individually eliminated. These are Volume/Capacity Ratio, Sight Distance, Driver Expectancy, and Information Systems Deficiencies. Since a considerable amount of time and data are required to develop these Indicator Values, it is felt that these indicators are not cost-effective for use in the Yellowstone County Program.

Three of the indicators, Number of Accidents, Accident Rate, and Accident Severity, have a significant effect on the Hazard Index and were therefore studied further. A Hazard Index was determined for each location using all possible combinations of these three indicators. The results of this analysis are shown on Table 4.

A review of this information indicates wide fluctuations when only one indicator is used to determine a Hazard Index. When combined, however, the fluctuation is reduced greatly. With the three indicators combined it appears the relative Hazard Index correlates well with the results obtained using the initial seven indicators. The only data required to obtain the indicator values for Number of Accidents, Accident Rates, and Accident Severity are accident records and traffic counts. Since these data are easy to obtain and the method of determining the Indicator Values is not highly technical, the evaluation program is simple and cost-effective. The recommended evaluation program includes only these three indicators.

TABLE 3

YELLOWSTONE COUNTY HIGH HAZARD LOCATION STUDY*
HAZARD INDEX SENSITIVITY

Rank	Hazard Index With All Indicators	No. of Accidents Indicator Deleted	Accident Rate Indicator Deleted	Accident Severity Indicator Deleted	V/C Ratio Indicator Deleted	Sight Distance Indicator Deleted	Driver Expectancy Indicator Deleted	Informatio Systems Indicator Deleted
1	2-62.32	2-65.32	2-51.38	16-65.30	2-66.99	16-64.89	2-63.95	2-66.38
2	16-60.09	7-62.09	12-50.00	2-61.68	16-63.50	7-60.66	16-59.40	16-59.97
3	7-56.17	16-57.56	16-48.50	7-54.08	7-60.47	2-59.31	7-54.79	7-55.80
4	5-50.79	5-54.47	5-46.66	6-48.92	5-54.07	18-50.76	18-50.74	18-52.42
5	18-49.74	18-54.40	7-43.45	18-48.02	18-53.56	6-50.58	5-50.58	5-51.93
6	12-47.08	12-50.04	3-41.95	5-47.68	6-49.41	5-49.49	1-47.38	6-50.71
7	6-46.84	14-46.85	20-40.83	4-42.41	12-49.14	1-48.21	6-46.46	12-49.16
8	14-44.75	20-46.52	8-40.50	20.42.22	14-47.14	20.46.43	12-46.22	14-46.53
9	1-44.64	6-46.03	14-40.32	3-42.00	1-46.48	4-46.16	14-44.70	1-45.11
10	20-44.47	1-44.17	1-40.18	12-41.90	20-45.85	14-46.09	20-44.37	20-44.40
11	4-43.48	3-42.22	15-39.90	14-40.68	4-45.22	12-43.25	4-42.69	3-43.64
12	3-42.19	17-38.80	4-39.85	1-39.83	3-43.37	8-41.44	3-42.22	4-43.15
13	8-38.37	15-38.23	19-38.95	19-35.66	8-38.85	3-39.95	8-42.12	19-38.37
14	17-36.70	8-38.04	18-36.59	8-33.73	17-38.73	17-39.63	17-38.05	17-36.79

* In all columns in this table, the Location Number precedes the dash; the Hazard Index follows the dash.

Continued

TABLE 3
(Continued)

Rank	Hazard Index With All Indicators	No. of Accidents Indicator Deleted	Accident Rate Indicator Deleted	Accident Severity Indicator Deleted	V/C Ratio Indicator Deleted	Sight Distance Indicator Deleted	Driver Expectancy Indicator Deleted	Information Systems Indicator Deleted
15	19-36.49	4-36.92	11-34.04	17-33.56	19-38.05	15-36.52	10-34.23	15-34.41
16	15-35.40	19-35.80	6-34.01	11-29.89	15-36.60	19-35.07	15-33.71	11-33.95
17	11-32.01	10-33.94	10-30.30	15-28.41	10-33.40	11-34.57	19-33.60	8-33.74
18	10-31.81	11-28.29	17-30.22	10-25.39	11-31.74	10-31.25	11-31.32	10-33.60
19	9-25.40	9-25.29	9-29.87	13-18.59	9-24.81	9-27.43	9-27.22	9-27.53
20	13-24.40	13-22.90	13-28.00	9-15.34	13-23.81	13-24.75	13-27.10	13-25.62

NOTE: Locations are listed in order of decreasing Hazard Index

Source: HKM Associates

TABLE 4

YELLOWSTONE COUNTY HIGH HAZARD LOCATION STUDY*
HAZARD INDEX USING COMBINATIONS OF INDICATORS 1, 2 & 3

Rank	Hazard Index Using Ind. 1,2, & 3	H.I. Using Ind. 1 & 2	H.I. Using Ind. 1 & 3	H.I. Using Ind. 2 & 3	H.I. Using Ind. 1	H.I. Using Ind. 2	H.I. Using Ind. 3
1	2-73.50	16-88.61	2-56.70	2-83.94	16-72.99	2-100.00	12-69.01
2	16-71.95	2-77.66	1-56.70	7-83.94	11-50.98	16-100.00	9-68.01
3	7-67.55	6-74.14	16-54.17	16-71.54	6-50.98	7-100.00	15-65.03
4	18-62.98	7-68.79	12-51.92	6-66.68	2-47.01	18- 95.02	1-65.03
5	6-62.24	18-65.91	8-49.69	5-64.54	1-47.01	6- 91.02	7-65.03
6	1-57.98	1-54.52	5-49.21	14-60.91	3-42.01	5- 65.02	2-65.03
7	5-55.34	5-51.11	14-49.07	20-55.63	4-40.00	14- 60.00	5-63.98
8	14-53.31	4-49.25	9-48.59	17-54.88	8-40.00	1- 60.00	14-61.99
9	20-49.52	14-49.05	1-46.99	4-52.33	19-40.00	17- 59.02	10-59.01
10	4-48.84	20-47.33	11-45.61	12-51.71	14-34.02	20- 57.02	8-58.01
11	17-46.71	17-45.09	20-44.76	1-48.39	20-34.02	4- 56.00	18-57.02
12	12-46.14	3-42.60	15-44.68	10-47.11	13-32.01	3- 43.02	20-53.98
13	3-42.72	11-35.96	4-44.31	8-43.41	12-32.01	10- 37.02	17-50.00
14	8-42.45	12-34.91	6-44.00	3-43.00	5-32.01	12- 37.02	13-49.00

* In all columns in this table, the Location Number precedes the dash; the Hazard Index follows the dash.

Continued

TABLE 4
(Continued)

Rank	Hazard Index Using Ind. 1,2, & 3	H.I. Using Ind. 1 & 2	H.I. Using Ind. 1 & 3	H.I. Using Ind. 2 & 3	H.I. Using Ind. 1	H.I. Using Ind. 2	H.I. Using Ind. 3
15	10-39.72	8-34.81	18-42.68	15-40.67	9-25.98	8- 31.02	4-48.01
16	11-37.62	19-33.06	3-42.54	9-36.63	17-25.98	19- 28.00	3-42.98
17	19-35.34	10-30.26	10-41.44	18-36.42	18-25.98	11- 25.02	19-40.00
18	15-35.10	13-20.44	13-41.15	19-33.51	7-25.98	15- 20.00	11-40.99
19	9-33.62	15-20.41	19-40.00	11-32.36	15-20.98	13- 12.00	6-38.01
20	13-29.84	9-16.74	17-38.90	13-28.99	10-20.98	9- 10.00	16-38.01

NOTE: Indicator 1 is No. of Accidents/Yr.

Indicator 2 is Accident Rate

Indicator 3 is Accident Severity

Source: HKM Associates

The effects of the Cost Factor were also studied by varying the weighting factor used to determine the Priority Index. For the initial evaluation the Hazard Index was weighted 0.75 and the Cost Factor was weighted 0.25. Using the initial Hazard Indexes and Cost Factors, new Priority Indexes were determined using weighting factors of 0.85 and 0.15 respectively and 0.65 and 0.35 respectively. The results of this analysis are shown on Table 5.

Weighting the Cost Factor 0.25, those locations where signing improvements only are recommended generally receive highest priority. A higher Cost Factor weight decreases the emphasis on the Hazard Index and vice versa.

In general, if signing improvements will reduce the hazardousness of a location and total reconstruction is not necessary, the improvements would appear to have a high benefit/cost ratio. A weighting factor of 0.25 for the Cost Factor provides results which correlate with this concept; therefore 0.25 is used in the Priority Index formula in the final evaluation program. It should be noted that this weighting factor is somewhat arbitrary and can be adjusted as desired by local officials.

TABLE 5

YELLOWSTONE COUNTY HIGH HAZARD LOCATION STUDY*
PRIORITY INDEX ANALYSIS

Rank	Hazard Index Using All 7 Indicators	Priority Index 0.75(H.I.) + 0.25(C.F.)	Priority Index 0.85(H.I.) + 0.15(C.F.)	Priority Index 0.65(H.I.) + 0.35(C.F.)
1	2-62.32	16-70.1	16-66.8	16-74.1
2	16-60.09	7-67.1	7-62.7	7-71.5
3	7-56.17	18-61.6	18-56.8	18-66.3
4	5-50.79	12-59.6	5-55.8	12-65.0
5	18-49.74	5-59.1	12-54.6	14-64.1
6	12-47.08	14-58.6	2-54.5	4-63.3
7	6-46.84	4-57.6	14-53.0	3-62.4
8	14-44.75	3-56.6	4-52.0	5-62.4
9	1-44.64	1-53.2	3-50.9	17-58.9
10	20-44.47	17-52.5	1-49.8	1-56.7
11	4-43.48	19-49.4	17-46.2	19-54.5
12	3-42.19	2-49.2	20-45.9	15-47.9
13	8-38.37	20-46.9	19-44.2	20-47.8
14	17-36.70	15-44.3	15-40.7	2-44.0

* In all columns in this table, the Location Number preceeds the dash; the Hazard Index or Priority Index follows the dash.

Continued

TABLE 5
(Continued)

Rank	Hazard Index Using All 7 Indicators	Priority Index 0.75(H.I.) + 0.25(C.F.)	Priority Index 0.85(H.I.) + 0.15(C.F.)	Priority Index 0.65(H.I.) + 0.35(C.F.)
15	19-36.49	6- N/A	6- N/A	6- N/A
16	15-35.40	8- N/A	8- N/A	8- N/A
17	11-32.01	11- N/A	11- N/A	11- N/A
18	10-31.81	10- N/A	10- N/A	10- N/A
19	9-25.40	9- N/A	9- N/A	9- N/A
20	13-24.40	13- N/A	13- N/A	13- N/A

N/A = Not Applicable as no action is recommended

D. RECOMMENDED EVALUATION PROGRAM

D. RECOMMENDED EVALUATION PROGRAM

The program recommended for evaluation of hazardous locations in Yellowstone County, Montana, is presented in this section of the report. This program utilizes a Hazard Index and a Cost Factor to prioritize hazardous locations.

Report No. FHWA-RD-77-82 "Identification of Hazardous Locations" was used in the development of the Hazard Index.

The Hazard Index is strictly a measure of the hazardousness of a location. Consideration should also be given to the relative benefit of improvements at each location as compared to the cost of those improvements. The Cost Factor attempts to adjust the priority of each location utilizing this benefit/cost concept.

Hazard Index (H.I.)

The Hazard Index is developed using the following three parameters or indicators:

1. Number of Accidents
2. Accident Rate
3. Accident Severity

Each of these indicators is a measure of some aspect of hazardousness of a particular location. The raw data for each of these indicators must be converted to an Indicator Value for use in the Hazard Index Formula. This is accomplished by the use of charts developed for that purpose. These charts are presented later in this section of the report.

Indicator Values range from 0 to 100. Larger values indicate higher degress of hazardousness. Four control values are

used in establishing the charts as follows:

1. An indicator value of 0 indicates there is no contribution to hazardousness from a particular source.

2. An indicator value of 33 is the value used to separate hazardous sites from "normal" sites.

3. An indicator value of 67 or above indicates a very hazardous site.

4. An indicator value of 100 is the highest value possible.

Some indicators are stronger than others, of course, and the individual Indicator Values are therefore weighted according to their ability to predict future accident experience. Since the sum of the weighting factors is 1.00, the Hazard Index will also have a value of from 0 to 100. Again a larger Hazard Index Value indicates a more hazardous location.

The Hazard Index is developed using the following relationship:

$$H.I. = 0.283\,(I.V.)_{\text{Number of Accidents}} + 0.388\,(I.V.)_{\text{Accident Rate}} + 0.329\,(I.V.)_{\text{Accident Severity}}$$

where I.V. is the Indicator Value for that particular indicator. Following is an explanation of each of the indicators in the Hazard Index formula.

Indicator 1: Number of Accidents

A primary strength of this indicator is that data are continuously collected through accident reporting procedures and are easily accessible. Unfortunately, the use of past accident experience to predict future experience is limited by the randomness in accident occurrences, particularly at sites with a low or medium number of accidents per year.

The data value used to arrive at an Indicator Value is the average number of accidents per year using data from a three year period for a particular location. For a non-intersection location, a "spot" length of 0.3 miles should be used unless individual conditions warrant otherwise.

The control values for this indicator are as follows:

Indicator Value of 0	0 ACC/YR
Indicator Value of 33	1.5 ACC/YR
Indicator Value of 67	7.0 ACC/YR
Indicator Value of 100	30.0 ACC/YR

These data values were selected to be responsive to local conditions. Figure 3 shows the relationship between Number of Accidents per Year and Indicator Value.

Indicator 2: Accident Rate

This indicator is one of the most accepted factors in determining the hazardousness of a particular location because it combines numbers of accidents with traffic volumes. The use of the Accident Rate indicator alone, however, can be misleading. For example, a few accidents on a low volume road will result in a very high accident

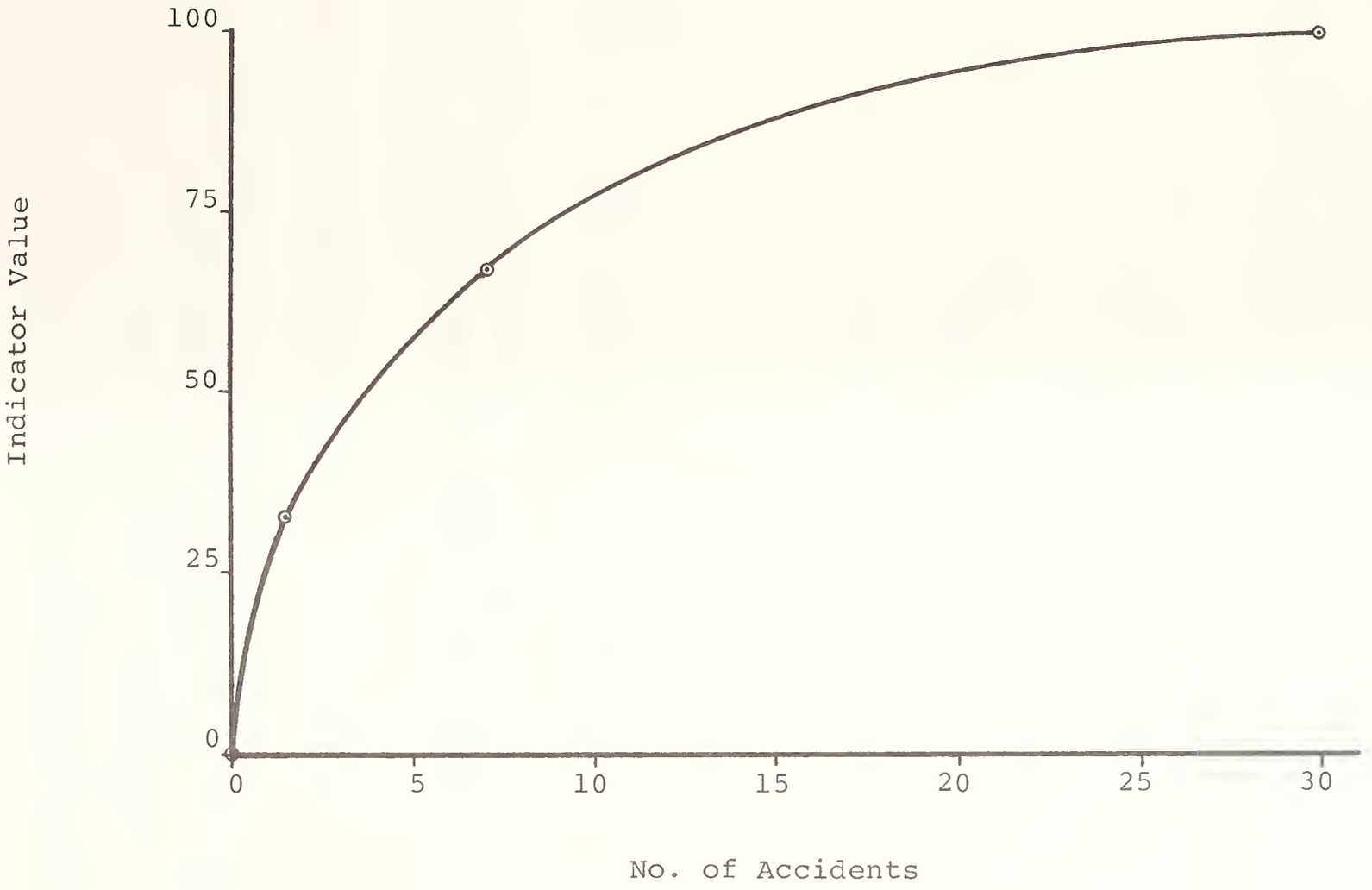


Figure 3. Indicator Values for Number of Accidents.

rate and will give too much emphasis to this location when compared to a high volume intersection with a high number of accidents producing a low accident rate.

The inclusion of both accident number and accident rate indicators in the Hazard Index Formula tends to offset the major deficiency in each so that high volume locations can be compared on an equal basis with low volume locations.

The data value used to arrive at an Indicator Value is the number of accidents per million vehicles entering a location. Again a three year period should be used to account for the random occurrence of accidents. The accident rate can then be determined by dividing the number of accidents by the sum of the approach volumes.

Control values for the Accident Rate Indicator are as follows:

Indicator Value of 0	0 ACC/MEV
Indicator Value of 33	2 ACC/MEV
Indicator Value of 67	5 ACC/MEV
Indicator Value of 100	10 ACC/MEV

These control values were again selected to reflect local conditions. Figure 4 shows the relationship between ACC/MEV and Indicator Value.

Indicator 3: Accident Severity

This indicator provides a means of identifying the hazardousness of a location based on the severity of accidents at that location. If two locations have approximately equal accident rates, a difference in severity will be a stong indicator of which location is the more hazardous.

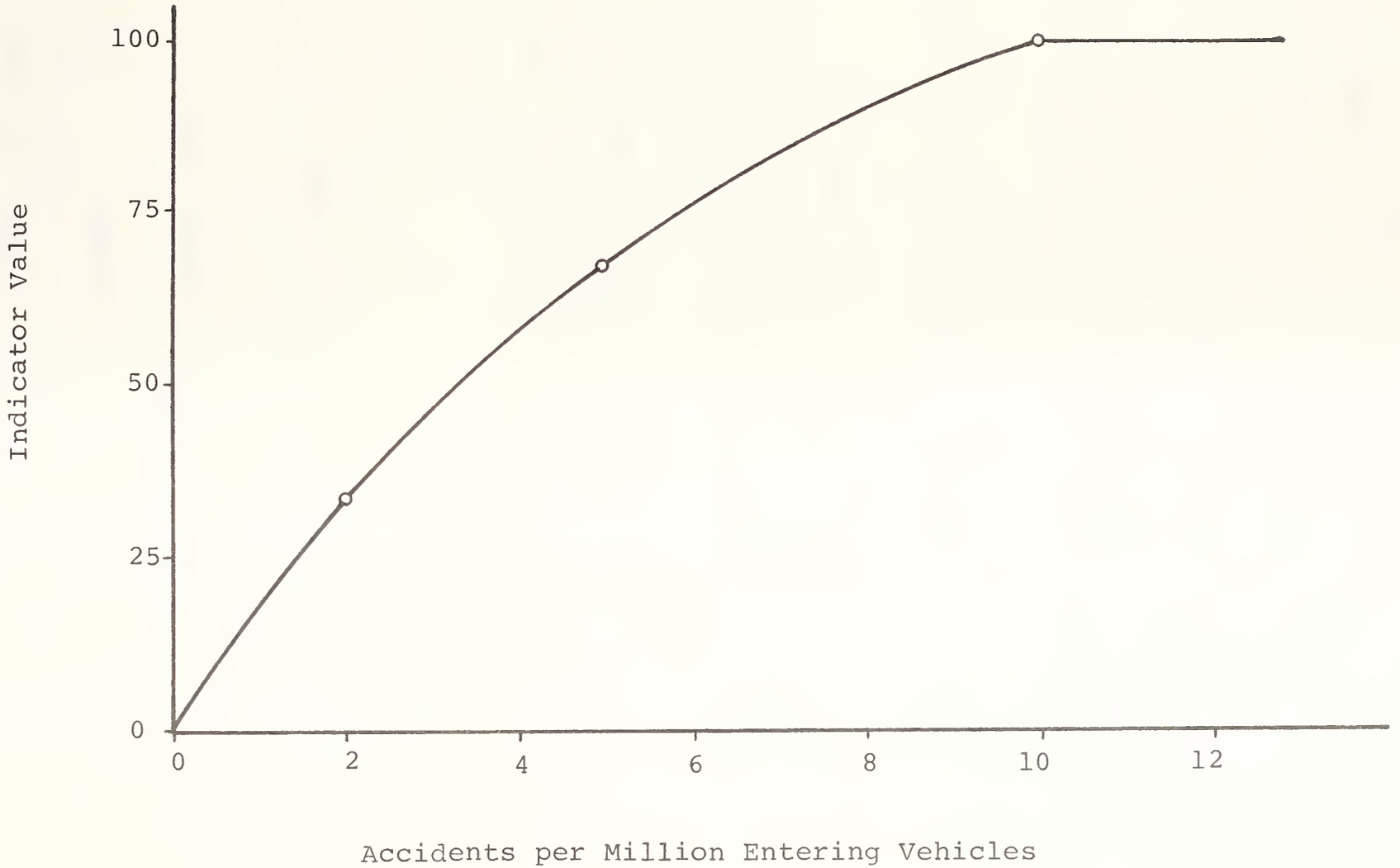


Figure 4. Indicator Values for Accident Rate.

The data input for this indicator is the "Average Relative Severity Index" (RSI). Again accidents over a three year period should be used to determine the RSI. The FHWA report recommends using RSI values as shown in Table 6. It should be noted that the RSI value for a particular location is not directly dependent on whether an accident is a personal injury accident or involves a fatality. The average number of fatalities, injuries, and property damage for all accidents within a category were taken into consideration when the RSI values were developed. In this manner a random accident involving a fatality is not overemphasized.

The FHWA report suggests the following Relative Severity Index values be used as control values:

Indicator Value of 0	avg RSI of $ 0
Indicator Value of 33	avg RSI of $ 2,000
Indicator Value of 67	avg RSI of $13,000
Indicator Value of 100	avg RSI of $30,000

It is recommended these control values be used in the Yellowstone County program. Figure 5 shows the relationship between average Relative Severity Index and Indicator Value.

Cost Factor

Once a Hazard Index has been determined for a location, an evaluation must be made to develop the recommended treatment for that location. A cost estimate must be prepared and the projected number of vehicles entering that location over a period of five years must be calculated. A five year period is recommended because this is a reasonable design life for a project involving new signing. If the recommended improvements for a location involve an alignment change or something other than signing, the design

TABLE 6

RELATIVE SEVERITY INDEX

Type of Accident	RSI Urban	RSI Rural
Multi-Vehicle, At Intersection		
Enginering at angle	$ 4,300	$14,400
From same direction -- both going straight	2,800	5,100
From same direction -- one turn, one straight	2,500	5,100
From same direction -- one stopped	3,800	5,200
From same direction -- all others	2,000	6,300
From opposite direction -- both going straight	4,000	20,000
From opposite direction -- one left turn, one straight	4,400	15,400
From opposite direction -- all others	2,700	3,800
Not stated	3,800	5,200
Multi-Vehicle, Non-Intersection		
Going opposite direction -- both moving	$ 4,400	$19,600
Going same direction -- both moving	2,900	8,100
One car parked	1,600	2,400
One car stopped in traffic	4,200	6,800
One car entering parked position	1,900	2,300
One car leaving parked position	1,200	2,700
One car entering alley or driveway	3,400	6,000
One car leaving alley or driveway	2,000	4,400
All others	1,700	7,600
Not stated	3,400	6,000
Motor Vehicle with Pedestrian, at Intersection and Non-Intersection		
Vehicle going straight	$20,000	$49,000
Vehicle turning right	13,600	11,200
Vehicle turning left	17,100	11,200
Vehicle backing	20,600	11,200
All others	14,500	11,200
Not stated	11,200	11,200
Single Vehicle, at Intersection		
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	5,500	7,000
Overturned in road	9,200	7,500
Left road	5,200	12,300

Continued

TABLE 6
(Continued)

Type of Accident	RSI	
Single Vehicle, Non-Intersection	Urban	Rural
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	6,300	9,200
Overturned in road	10,000	9,400
Left road at curve	7,600	12,400
Left road on straight road	5,200	10,500
Other One Motor Vehicle, At Intersection and Non-Intersection		
Fell from moving vehicle	$15,000	$57,200
Collision with animal	4,800	1,800
Collision with other object	4,700	4,400
All others	5,200	2,000
Not stated	3,200	3,400

Source: Report No. FHWA - RD -77-82
"Identification of Hazardous Locations"

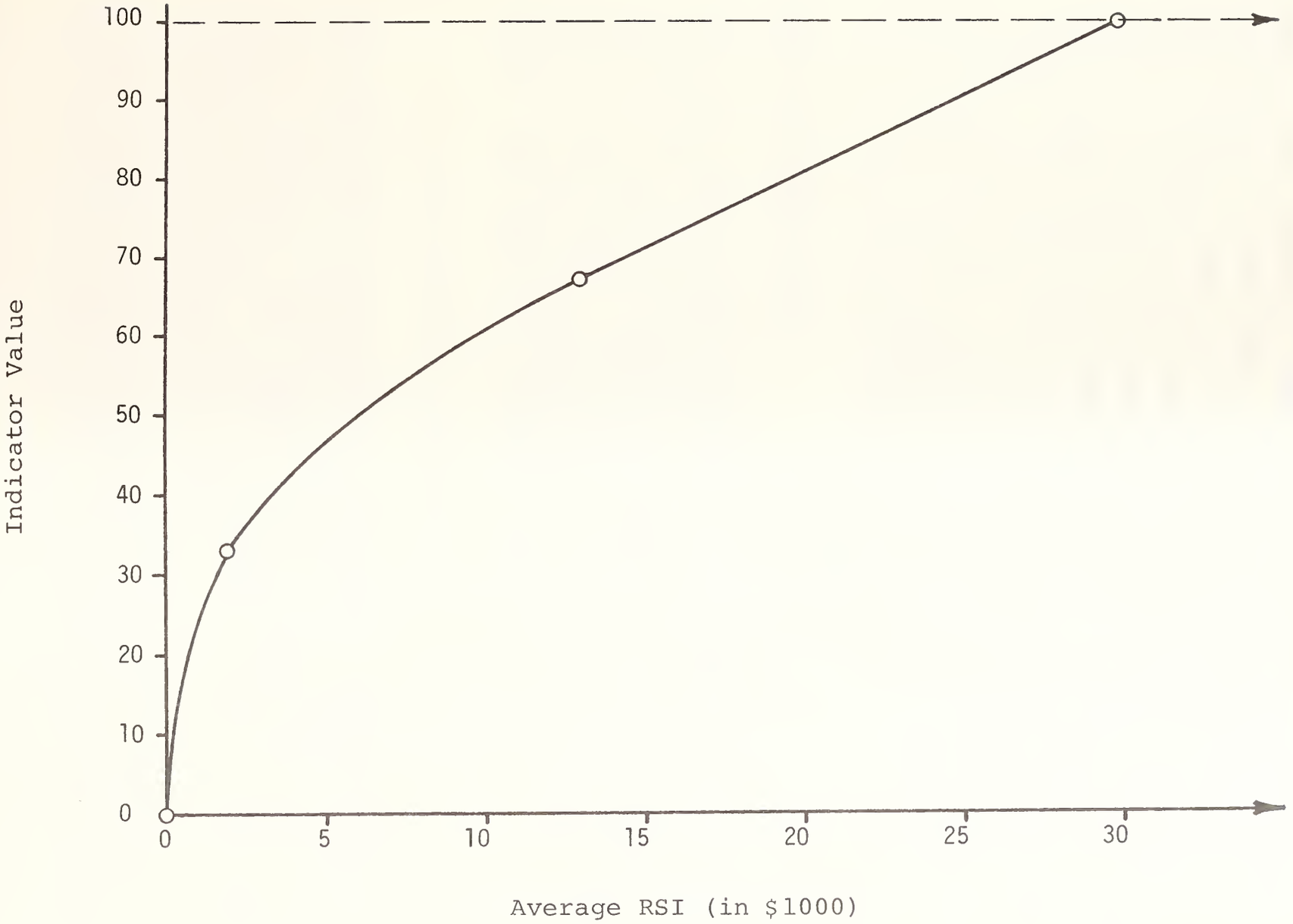


Figure 5. Indicator value for accident severity.

life will probably exceed five years, but using an analysis period exceeding five years tends to overemphasize those locations where signing improvements only are recommended.

Based on the above information a cost per 1000 vehicles is determined. A Cost Factor (C.F.) is then developed for that location using the chart shown on Figure 6. The Cost Factor will be a value ranging from 10 (highest cost per vehicle) through 100 (lowest cost per vehicle). The relationship between cost per 1000 vehicles and cost factor is linear. Any cost over $45.00 per 1000 vehicles is assigned a Cost Factor of 10. If no action is recommended for a particular location, it will simply drop to the bottom of the priority list. However, these locations should continue to be monitored annually.

Priority Index (P.I.)

The final step in the evaluation of hazardous locations is to develop a Priority Index (P.I.) for each location. The Priority Index is a weighted average of the Hazard Index and the Cost Factor. The Hazard Index is weighted 0.75 and the Cost Factor is weighted 0.25. The Priority Index formula thus takes the following form:

$$P.I. = 0.75\ (H.I.) + 0.25\ (C.F.)$$

The weighting factors used in the Priority Index formula are subject to modification based on local judgment. The factors presented here appear to be reasonable but are somewhat arbitrary. A form is provided (Figure 7) for use in determining the Priority Index.

A high Priority Index indicates the location in question has a high benefit/cost ratio. A priority list can then be

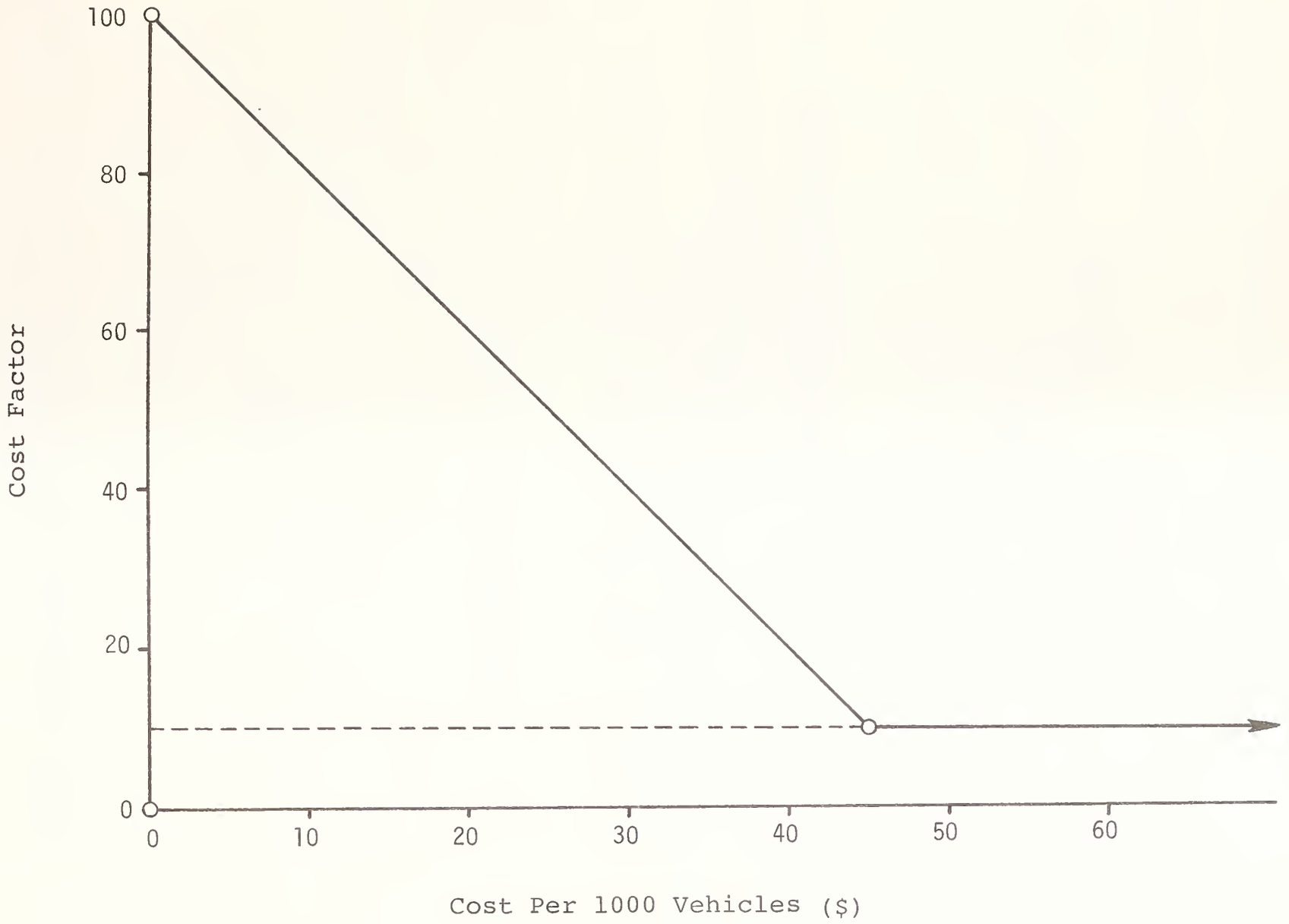


Figure 6. Form for determination of cost factor.

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number _____ Date _____

Site Description _____

HAZARD INDEX (H.I.)

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	_____	acc/yr	_____	x	0.283	=	_____
Accident Rate	_____	acc/MEV	_____	x	0.388	=	_____
Accident Severity	_____	dollars	_____	x	0.329	=	_____
			Sums:		_____*		_____

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{\_\_\_\_\_}{\_\_\_\_\_} = \_\_\_\_\_$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = _____%

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: _____ $/1000 vehicles

Cost Factor: _____

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = _____

Figure 7. Form for Determination of the Priority Index

prepared by ranking the locations from highest Priority Index to lowest Priority Index.

Since the Priority Index is not dependent on the number of locations studied, an ongoing program can be established whereby locations are evaluated as time and budgetary restrictions permit. The priority list can be adjusted according to the Priority Index as new locations are evaluated.

Continued monitoring of hazardous locations will be an important element of this program. Changes in traffic volumes or other conditions may necessitate a re-evaluation of a particular location. Also the effectiveness of improvements made at a location can be analyzed by future evaluation of the Hazard Index for that location. Any re-evaluation should not be made for at least three years after the improvements were made so that the data used in the re-evaluation will reflect the modified condition of the location.

E. EVALUATION AND RECOMMENDATIONS BY LOCATION

E. EVALUATION AND RECOMMENDATIONS BY LOCATION

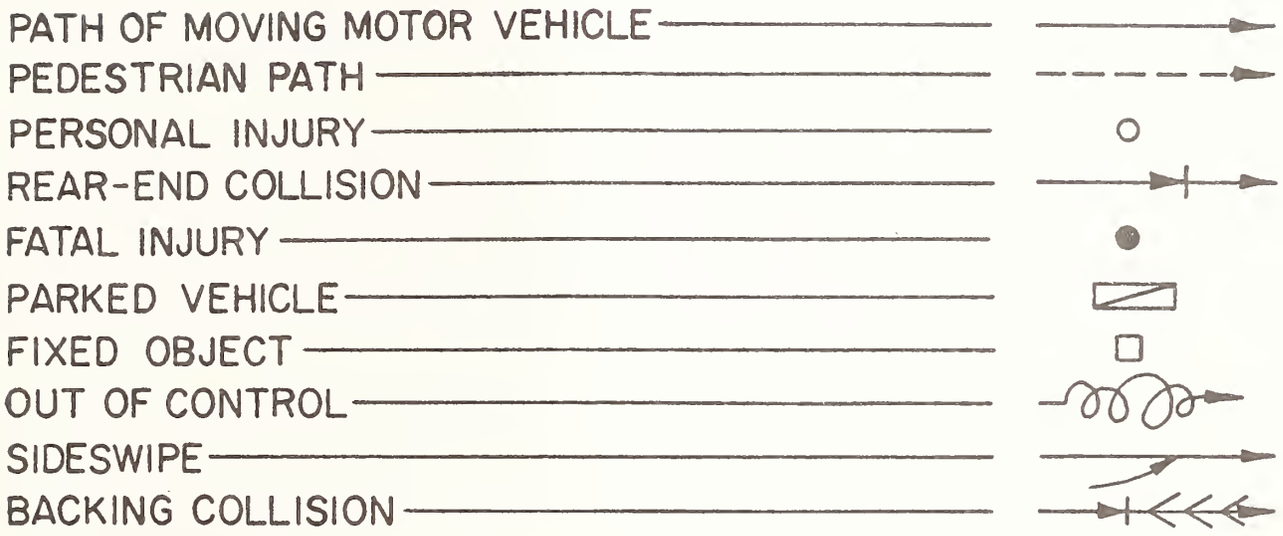
Each of the twenty locations referenced on pages 8 and 9 have been analyzed using the recommended evaluation program. The results of this analysis are presented in summary form in Table 1 on pages 3 through 5.

This section of the report discusses the evaluation and recommendations for each location. Information is presented in the following order by location:

- Evaluation and Recommendations
- Accident Summary Form
- Priority Index Determination Form
- Condition Diagram
- Accident Diagram
- Recommended Improvement Diagram (if applicable)

A legend for use with the accident diagrams is found on Figure 8 on page 43.

ACCIDENT DIAGRAM LEGEND



PAVEMENT: D=DRY W=WET
WEATHER: C=CLEAR F=FOG R=RAIN
SL=SLEET S=SNOW

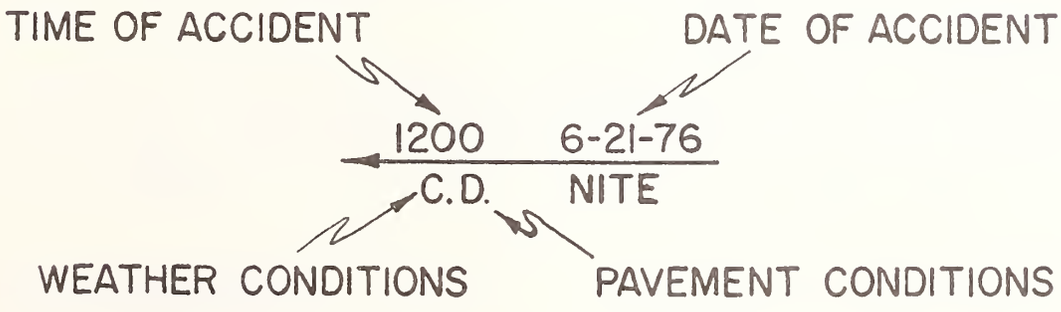


Figure 8

LOCATION NO. 1

This location is the connection of the MDOH construction with the old county road just west of the north end of the Shiloh Road overpass over Interstate 90.

Evaluation

This location consists of a sharp curve at the entrance to the Elk River plant. 1978 average daily traffic (ADT) is 2120 vehicles per day (VPD).

Ten accidents were reported at this location during the study period. All involved westbound vehicles which went off the south side of the road while negotiating the curve. Six of the accidents occurred on dry pavement. Seven occurred at night.

Existing curve data are as follows:

Δ = 50° 45' $\pm$
E = 20 ft. $\pm$
T = 90 ft.
R = 190 ft
e = 0.064 ft./ft.

Safe driving speed is determined to be 25 mph.

Existing signing at this location appears adequate. The problem appears to be that the curve is not adequate for the traffic speed on this road.

Recommended Improvement

Our recommendation is that this curve be reconstructed for a design speed of 50 mph. The preliminary cost estimate for this reconstruction is $48,100.00 including right-of-way acquisition and engineering fees.

SITE NUMBER 1 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
3	6	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	1	-	-	1	-	-	2	2	2	-	2

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	-	2	3	1	-	3

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
9	1	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
6	2	-	2	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK, UNLIGHTED
3	-	1	6

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	-	-	-	-	-	10	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
7	3	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
9	1	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	2	1	-
No. fatal.	-	-	1
No. P.D.O.	1	5	-

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 1 Date April 18, 1979

Site Description County Road west of north end of Shiloh Road overpass

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.33 acc/yr	47	x	0.283	=	13.30
Accident Rate	4.3 acc/MEV	60	x	0.388	=	23.28
Accident Severity	12,400 dollars	65	x	0.329	=	21.39
		Sums:		1.000*		57.97

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 10.98 $/1000 vehicles

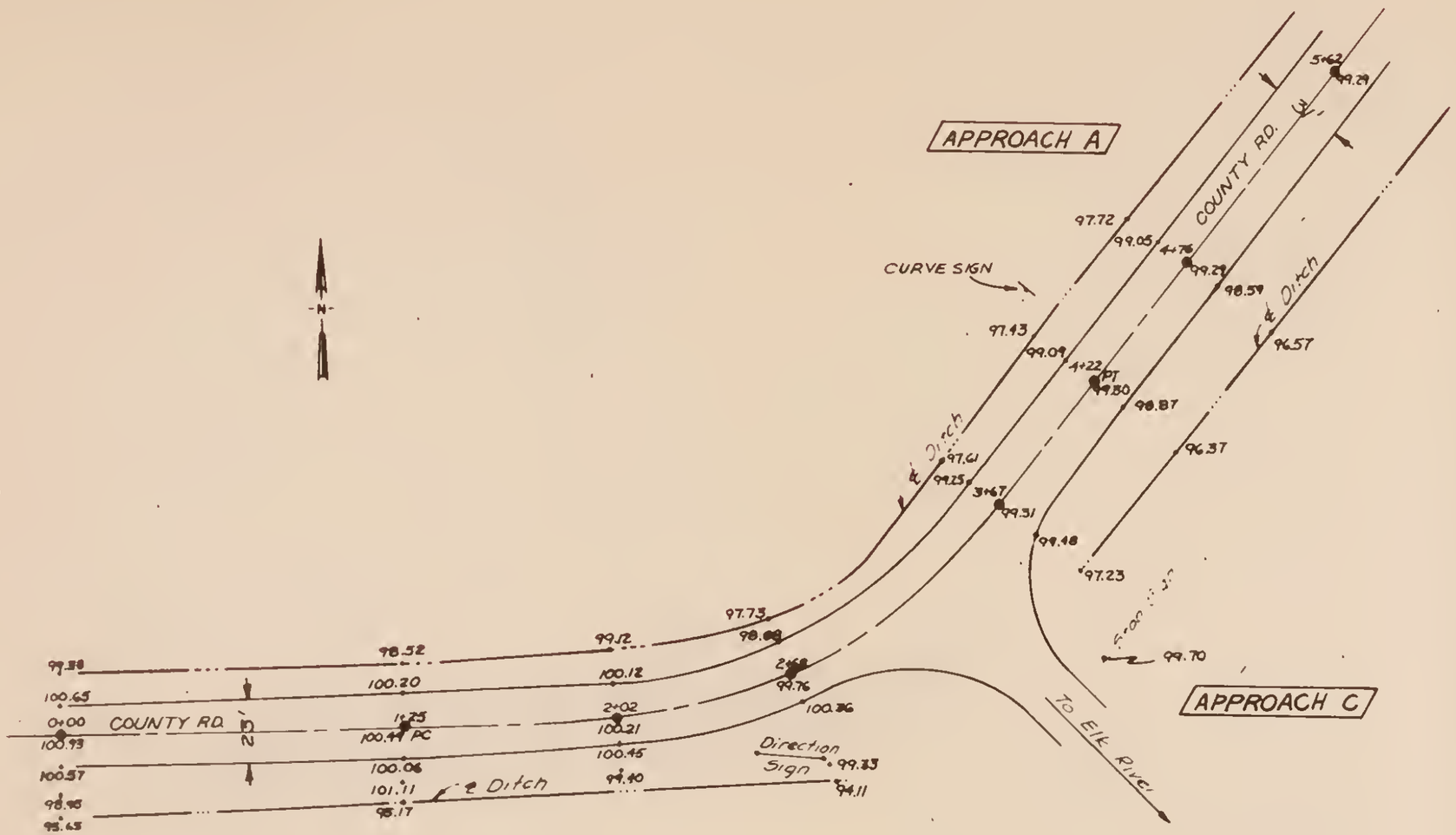
Cost Factor: 79

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 57.97 + 0.25 x 79

P.I. = 63.2

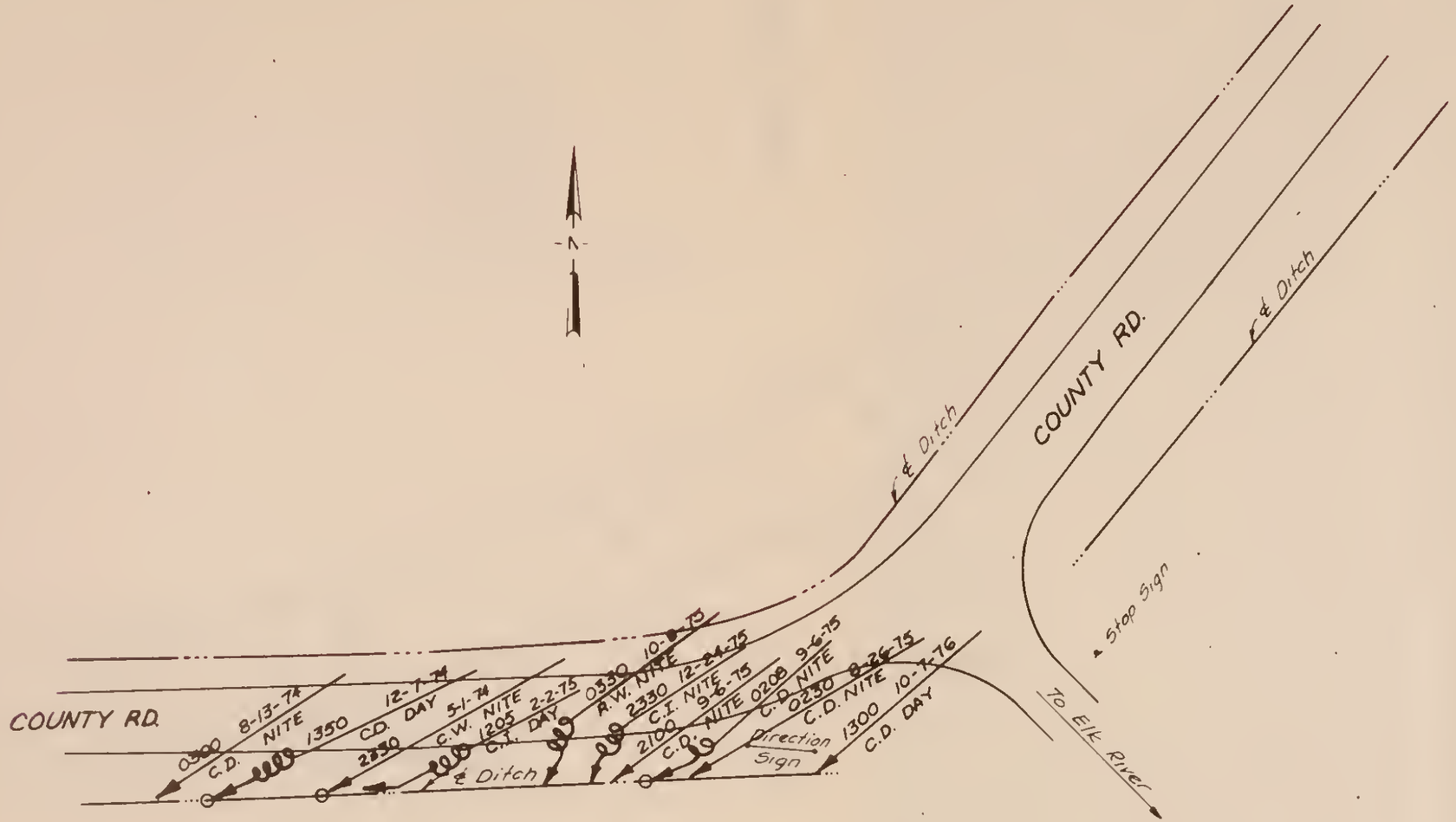


CONDITION DIAGRAM
LOCATION 1

COUNTY ROAD WEST OF NORTH
END OF SHILOH ROAD OVERPASS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 5.



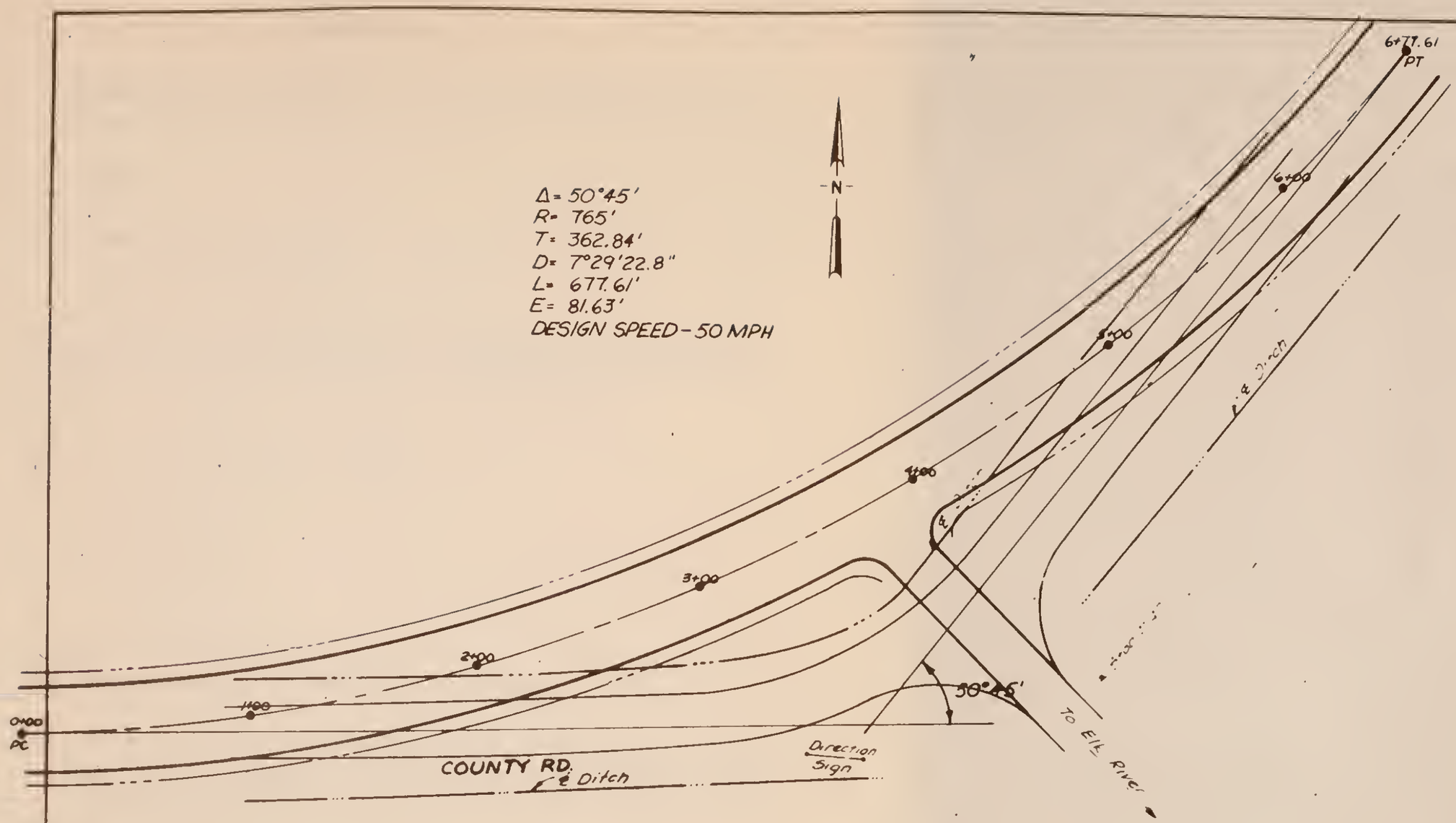
ACCIDENT DIAGRAM
LOCATION 1

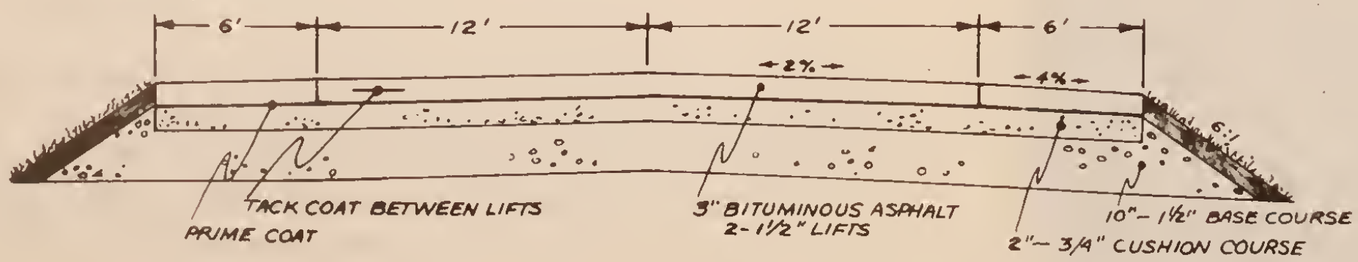
COUNTY ROAD WEST OF NORTH
END OF SHILOH ROAD OVERPASS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 6.

$\Delta = 50°45'$
$R = 765'$
$T = 362.84'$
$D = 7°29'22.8"$
$L = 677.61'$
$E = 81.63'$
DESIGN SPEED – 50 MPH





DETAIL NOT TO SCALE

IMPROVEMENT DIAGRAM
LOCATION 1

COUNTY ROAD WEST OF NORTH
END OF SHILOH ROAD OVERPASS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA PLATE 7.

LOCATION NO. 2

This location is the connection of Old Hardin Road with Dickie Road immediately east of Interstate 90.

Evaluation

This location is a sharp curve with drive approaches in it. 1978 ADT is 348 vehicles per day.

Ten accidents were reported during the study period. All accidents involved vehicles which left the roadway on the outside of the curve. Nine accidents occurred on dry pavement.

Existing curve data are as follows:

Δ = 76° 55' $\pm$
E = 38 ft.
T = 109 ft.
R = 137 ft.
e = 0.114

Safe driving speed is determined to be 25 mph.

The posted speed limit is 35 mph. Sight distance is less than desirable. Signing appears to be sufficient. The apparent cause of the hazardous conditions is that the curve is not adequate for the traffic speed.

Recommended Improvement

Our recommendation is that this curve be reconstructed to a 40 mph design speed. The preliminary cost estimate for this reconstruction is $119,400.00 including right-of-way acquisition and engineering. It is anticipated that acquisition of two homes will be required. This is reflected in the cost estimate.

SITE NUMBER 2 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
4	1	5

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	-	-	1	2	1	1	1	2	-	-	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
3	2	-	2	1	2	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
8	1	-	-	1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
9	1	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK, UNLIGHTED
4	3	-	3

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	-	2	-	-	-	8	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
4	5	1	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
10	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	4	-	3
No. fatal.	-	-	-
No. P.D.O.	1	1	2

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 2 Date April 18, 1979

Site Description Connection of Old Hardin Road with Dickie Road

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.33 acc/yr	47	x	0.283	=	13.31
Accident Rate	26.22 acc/MEV	100	x	0.388	=	38.80
Accident Severity	12,400 dollars	65	x	0.329	=	21.39
		Sums:		1.000*		73.50

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 166.05 $/1000 vehicles

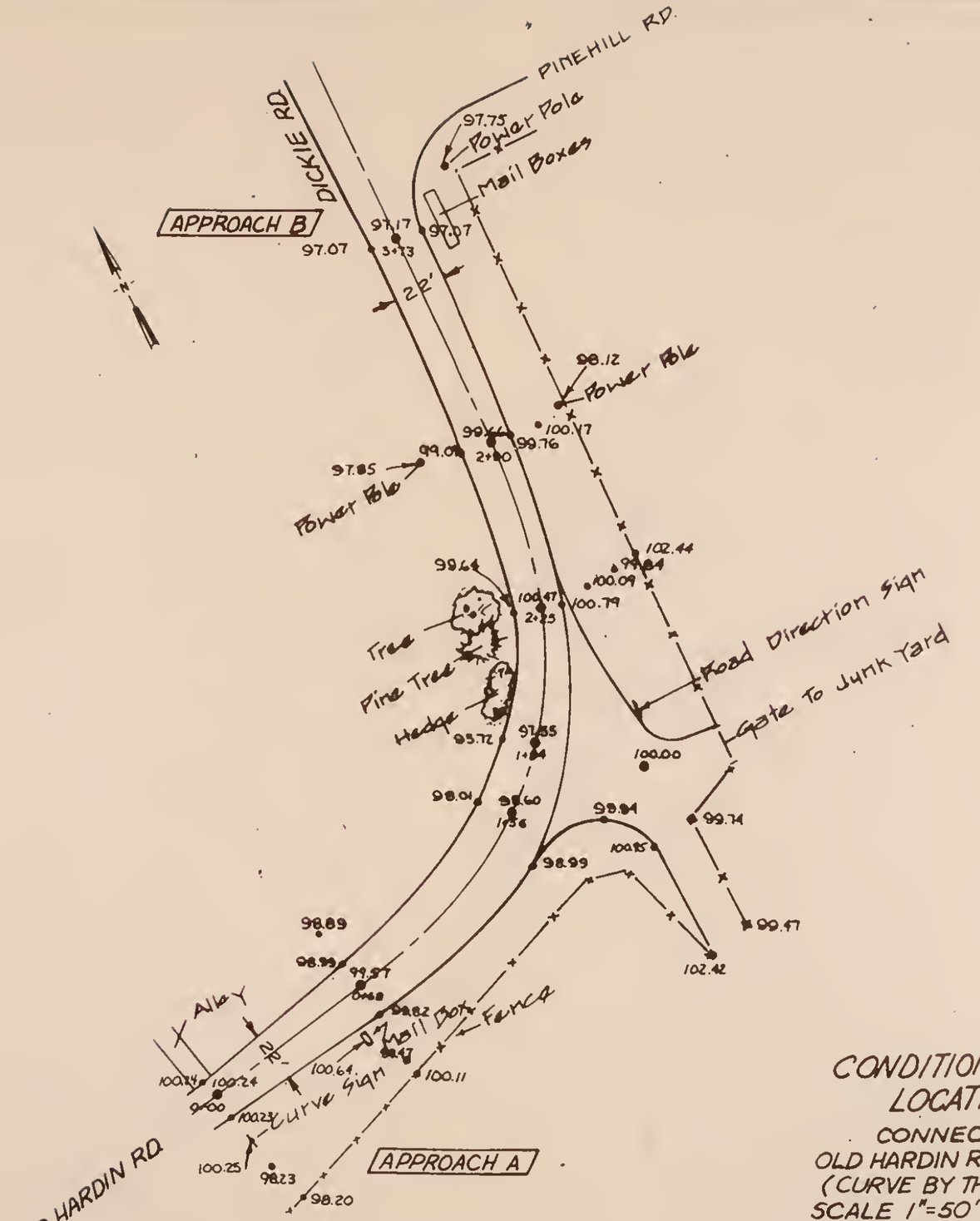
Cost Factor: 10

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 73.50 + 0.25 x 10

P.I. = 57.6

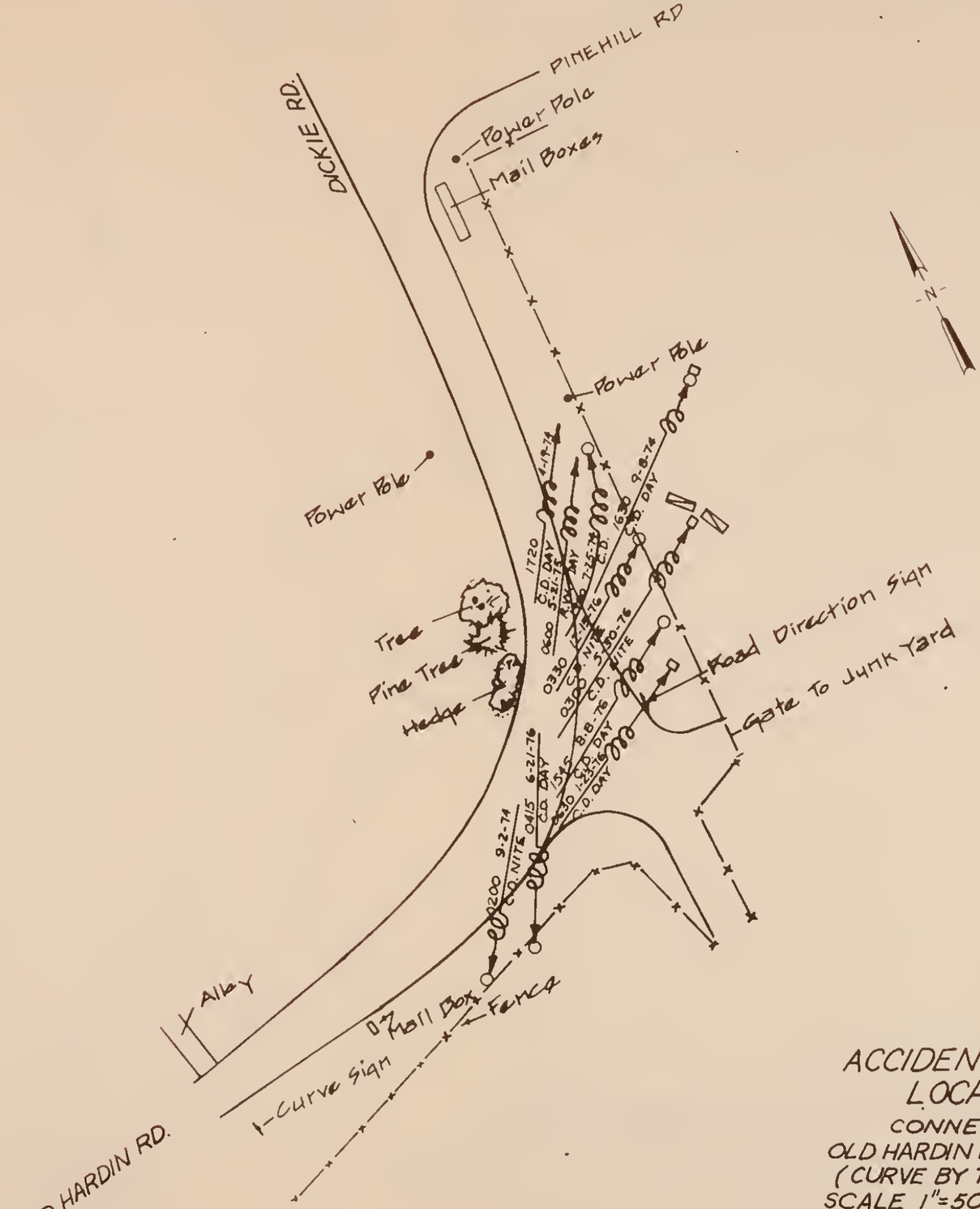


CONDITION DIAGRAM
LOCATION 2

CONNECTION OF
OLD HARDIN RD. WITH DICKIE RD.
(CURVE BY THE JUNK YARD)
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 8



ACCIDENT DIAGRAM
LOCATION 2
CONNECTION OF
OLD HARDIN RD. WITH DICKIE RD.
(CURVE BY THE JUNK YARD)
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 9.

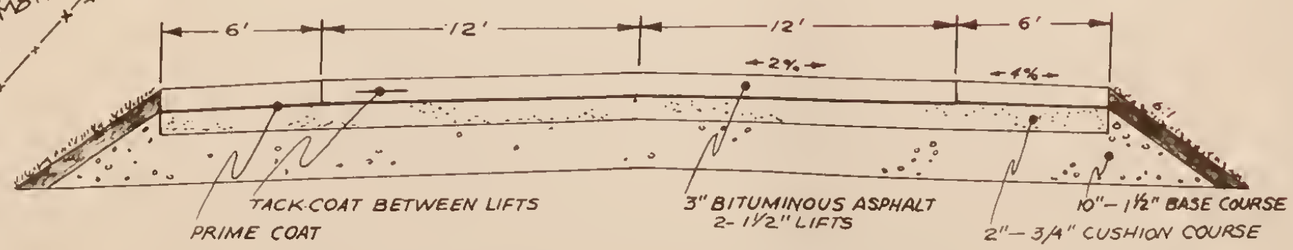
IMPROVEMENT DIAGRAM
LOCATION 2

CONNECTION OF
OLD HARDIN RD. WITH DICKIE RD.
(CURVE BY THE JUNK YARD)
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

Δ= 76°55'
R= 460'
T= 365.35'
D= 12°27'20.4"
L= 617.53'
E= 127.44'
DESIGN SPEED- 40 MPH





DETAIL NOT TO SCALE

PLATE 10.

LOCATION NO. 3

This location is the intersection of Bench Blvd. with Anchor Street.

Evaluation

Bench Blvd. is the through street at this location. Anchor Street is controlled by stop signs. 1978 ADT entering this location is approximately 2700 vehicles per day.

Eight accidents were reported during the study period. Five were right angle accidents and three involved turning movements. Five of the accidents occurred when the roadway was either wet or icy. All angle collisions involved eastbound vehicles.

The stop sign controlling the east bound movement on Anchor Street is largely hidden behind low trees in the Anchor Street right-of-way. This appears to be the problem at this location, particularly during the period when there are leaves on the trees. For several months each year the sign is almost totally obscured. It is also noted that both stop signs are not in good condition.

Recommended Improvements

Our recommendation is that the vegetation obscuring visibility of the eastbound stop sign on Anchor Street be removed. It is also recommended that the existing stop signs each be replaced with a new 30" R1-1 with hi-intensity reflective sheeting, thereby increasing their target value.

Estimated cost of these improvements is $790.00

SITE NUMBER 3 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	5	2

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
2	-	2	-	-	-	-	2	2	-	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	1	-	-	3	3	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
5	1	1	-	1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	2	-	3	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
6	-	-	2

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
7	-	1	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
4	4	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
8	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	3	1
No. fatal.	-	-	-
No. P.D.O.	1	2	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 3 Date April 18, 1979

Site Description Intersection of Bench Blvd. with Anchor Street

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.67 acc/yr	42	x	0.283	=	11.89
Accident Rate	2.7 acc/MEV	43	x	0.388	=	16.68
Accident Severity	4,412 dollars	43	x	0.329	=	14.15
		Sums:		1.000*		42.72

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.13 $/1000 vehicles

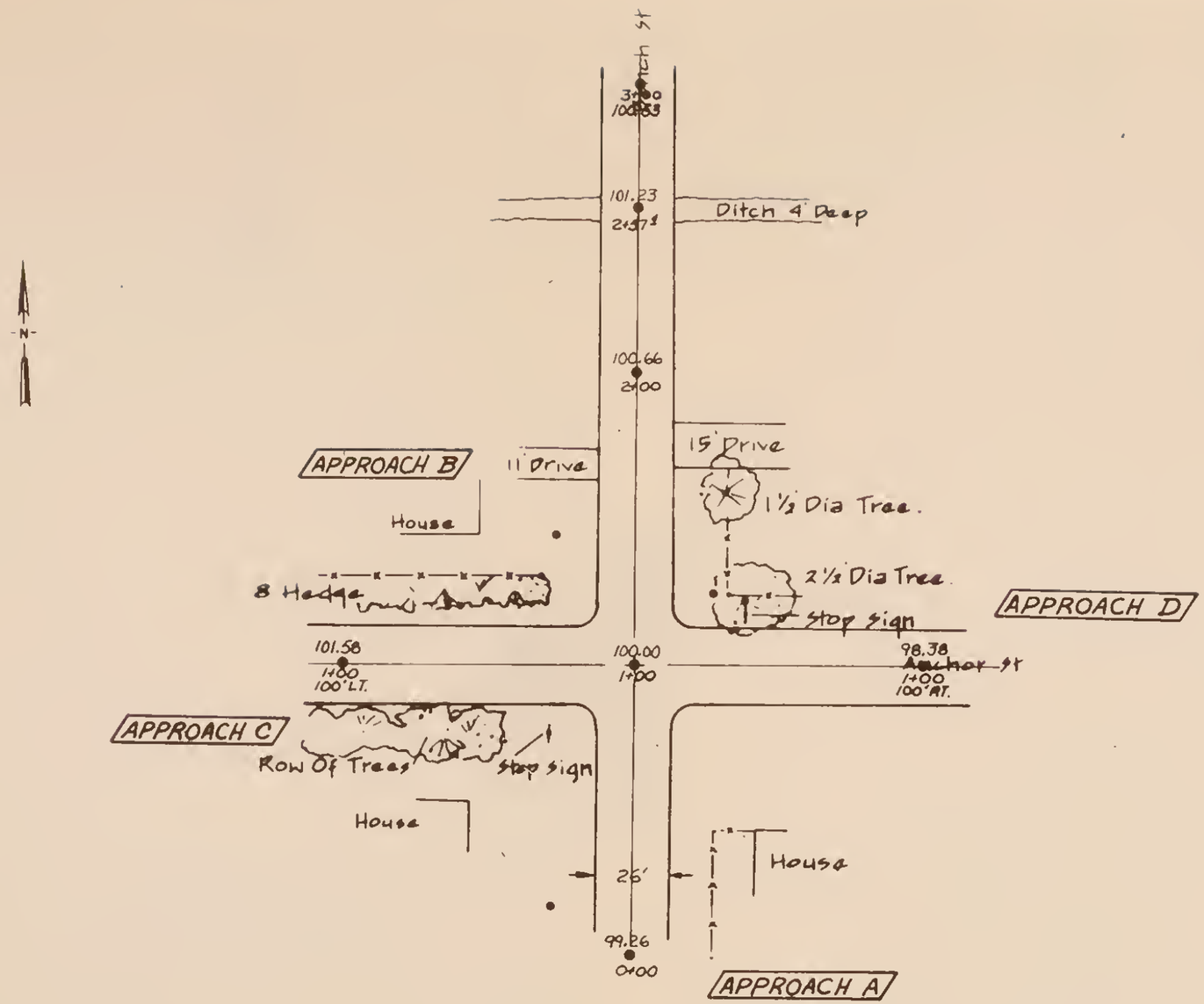
Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 42.72 + 0.25 x 100

P.I. = 57.0

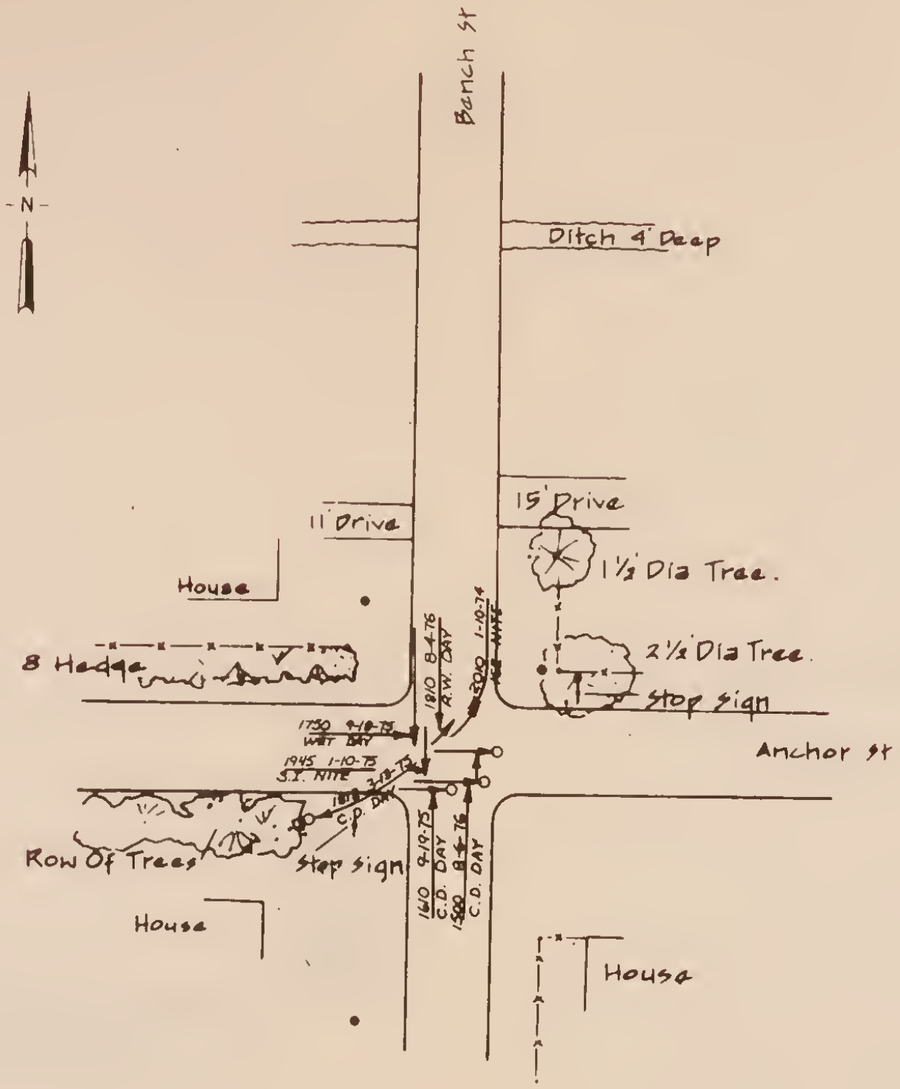


CONDITION DIAGRAM
LOCATION 3

INTERSECTION OF BENCH BLVD. AND ANCHOR ST.
IN BILLINGS HEIGHTS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 11.

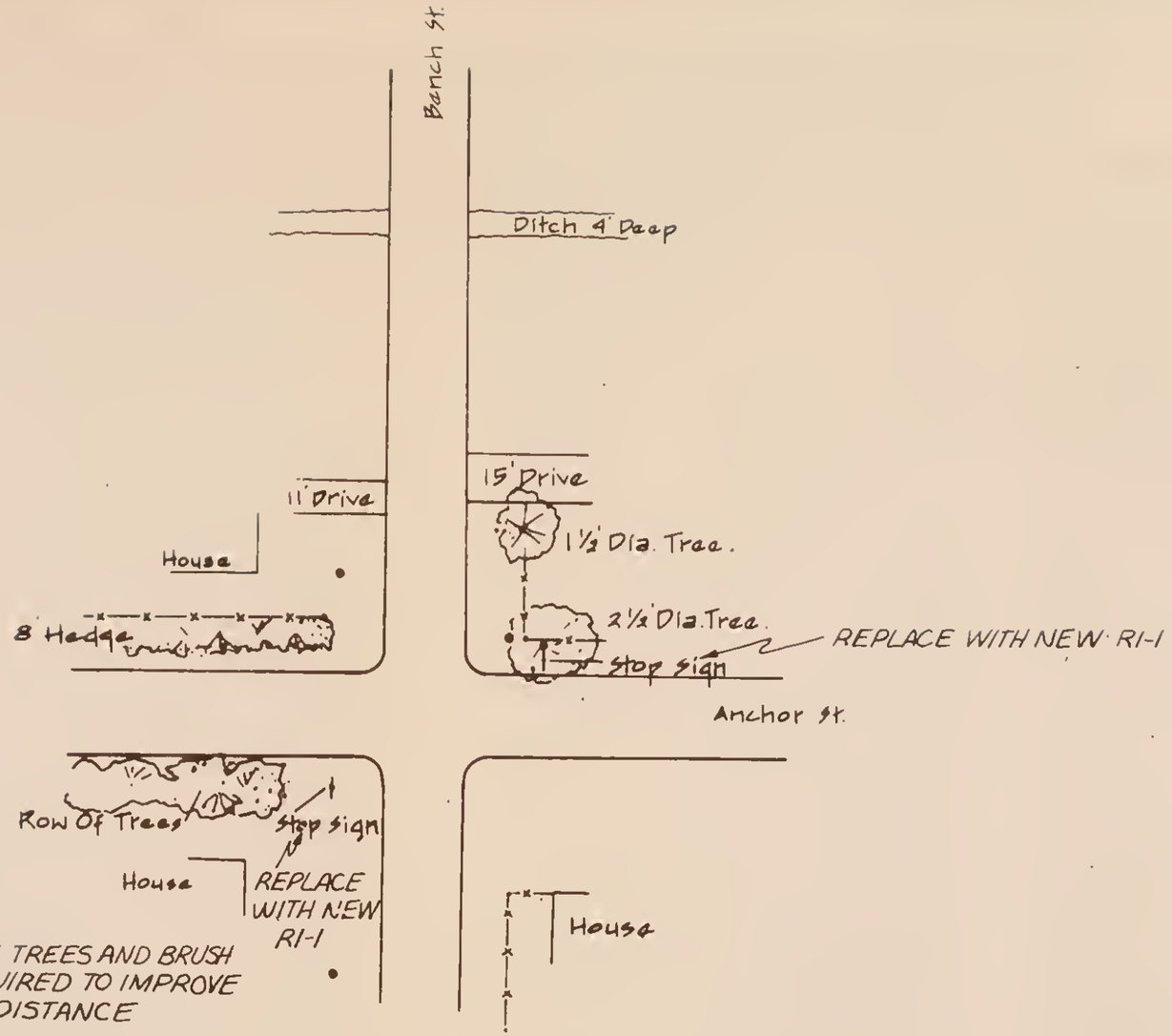


ACCIDENT DIAGRAM
LOCATION 3

INTERSECTION OF BENCH BLVD AND ANCHOR ST.
IN BILLINGS HEIGHTS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 12.



IMPROVEMENT DIAGRAM
LOCATION 3

INTERSECTION OF BENCH BLVD. AND ANCHOR ST.
IN BILLINGS HEIGHTS
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 13.

Location No. 4

This location is on Bench Blvd. at the entrance to Coulson Park.

Evaluation

The hazardous conditions at this location appear to be related to the curve on Bench Blvd. south of Coulson Park Road rather than the intersection itself. 1978 ADT on Bench Blvd. in this area is 1620 vehicles per day.

Seven accidents were reported during the study period. Six of these involved single vehicles which left the roadway. One involved an illegal maneuver at the intersection. All accidents occurred on dry pavement. Five occurred at night while two occurred during the day. There was no indication of alcohol in any accident.

Existing curve data have been determined as follows:

$= 54° 07'$
$E = 31$ ft.
$T = 129$ ft.
$R = 252$ ft.
$e = 0.081$ ft./ft.

Safe driving is determined to be 30 mph. The speed limit in this area is 35 mph.

Recommended Improvement

Our recommendation is to install curve warning signs (W1-2) with 30 mph advisory speed plates (W13-1) at both curve approaches. Delineators should also be installed through the curve. Estimated cost for these improvements is $200.00.

SITE NUMBER 4 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
-	2	5

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	1	2	-	1	-	-	1	1	1	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	1	1	2	1	-	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
7	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
7	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
2	-	-	5

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	-	3	-	-	-	3	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
3	2	2	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
7	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	1	5
No. fatal.	-	-	-
No. P.D.O.	-	1	2

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 4 Date April 18, 1979

Site Description Bench Blvd. at entrance to Coulson Park

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33 acc/yr	40	x	0.283	=	11.32
Accident Rate	3.94 acc/MEV	56	x	0.388	=	21.73
Accident Severity	6,014 dollars	48	x	0.329	=	15.79
		Sums:		1.000*		48.84

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.06 $/1000 vehicles

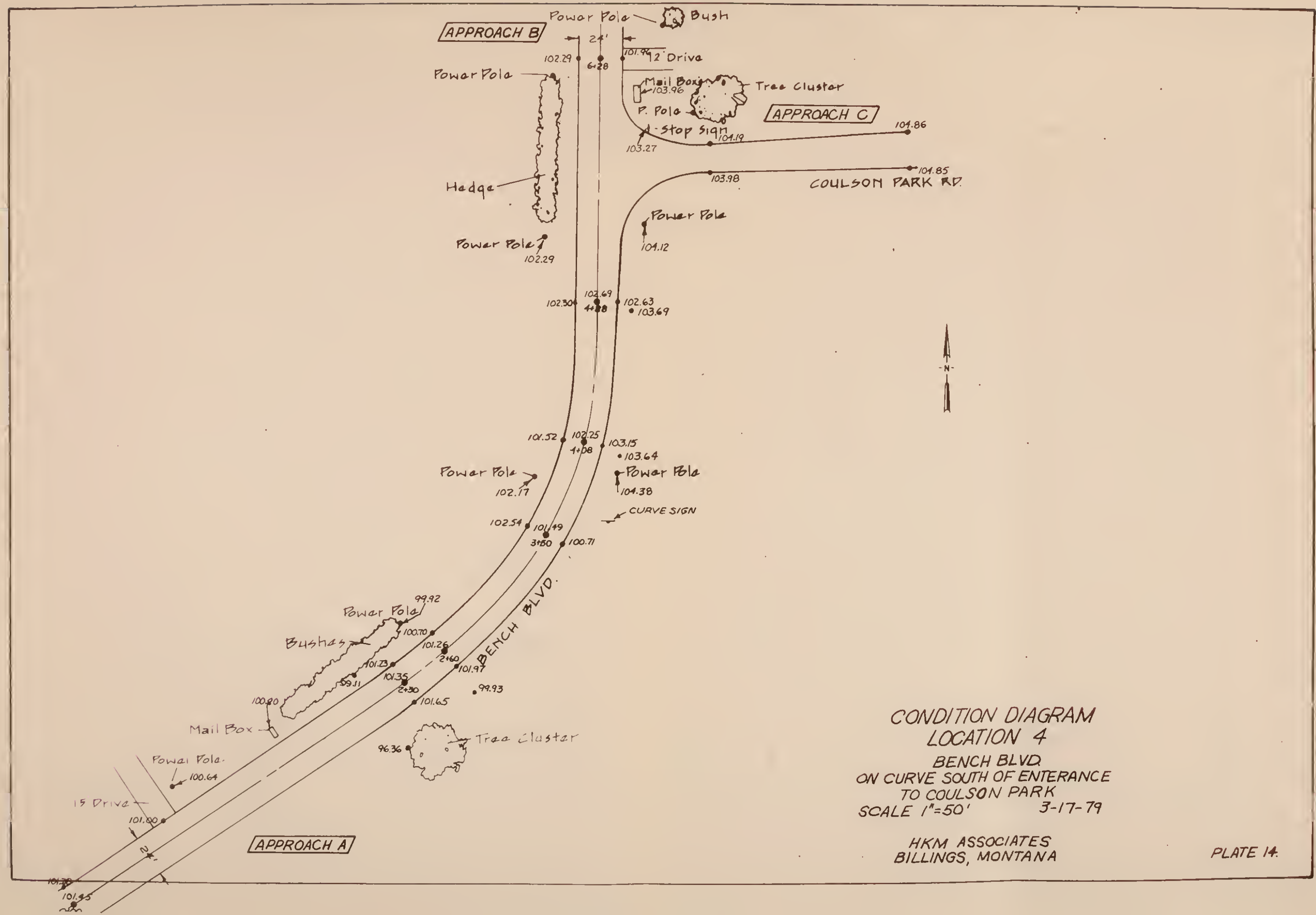
Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 48.84 + 0.25 x 100

P.I. = 61.6

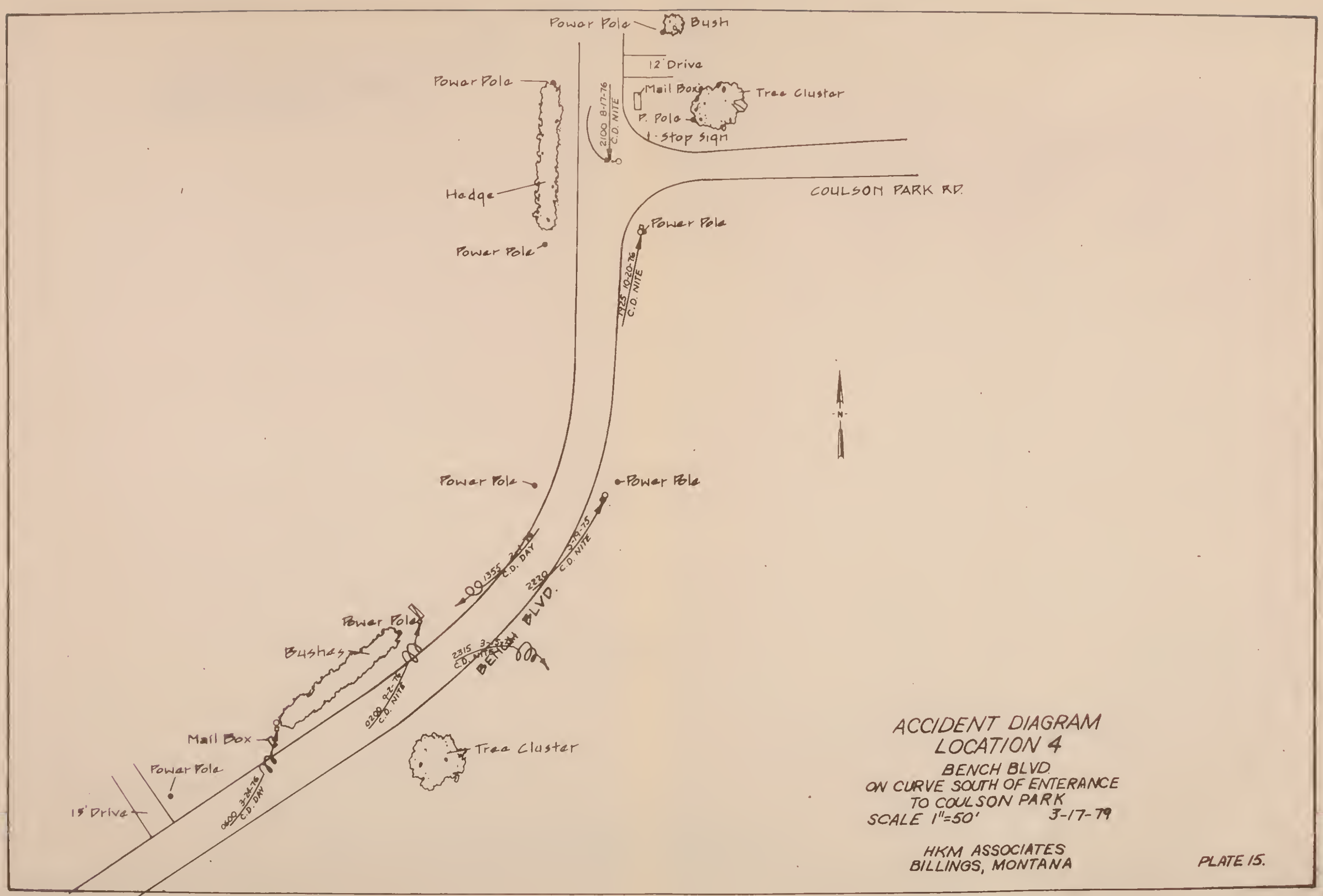


CONDITION DIAGRAM
LOCATION 4

BENCH BLVD.
ON CURVE SOUTH OF ENTERANCE
TO COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 14.

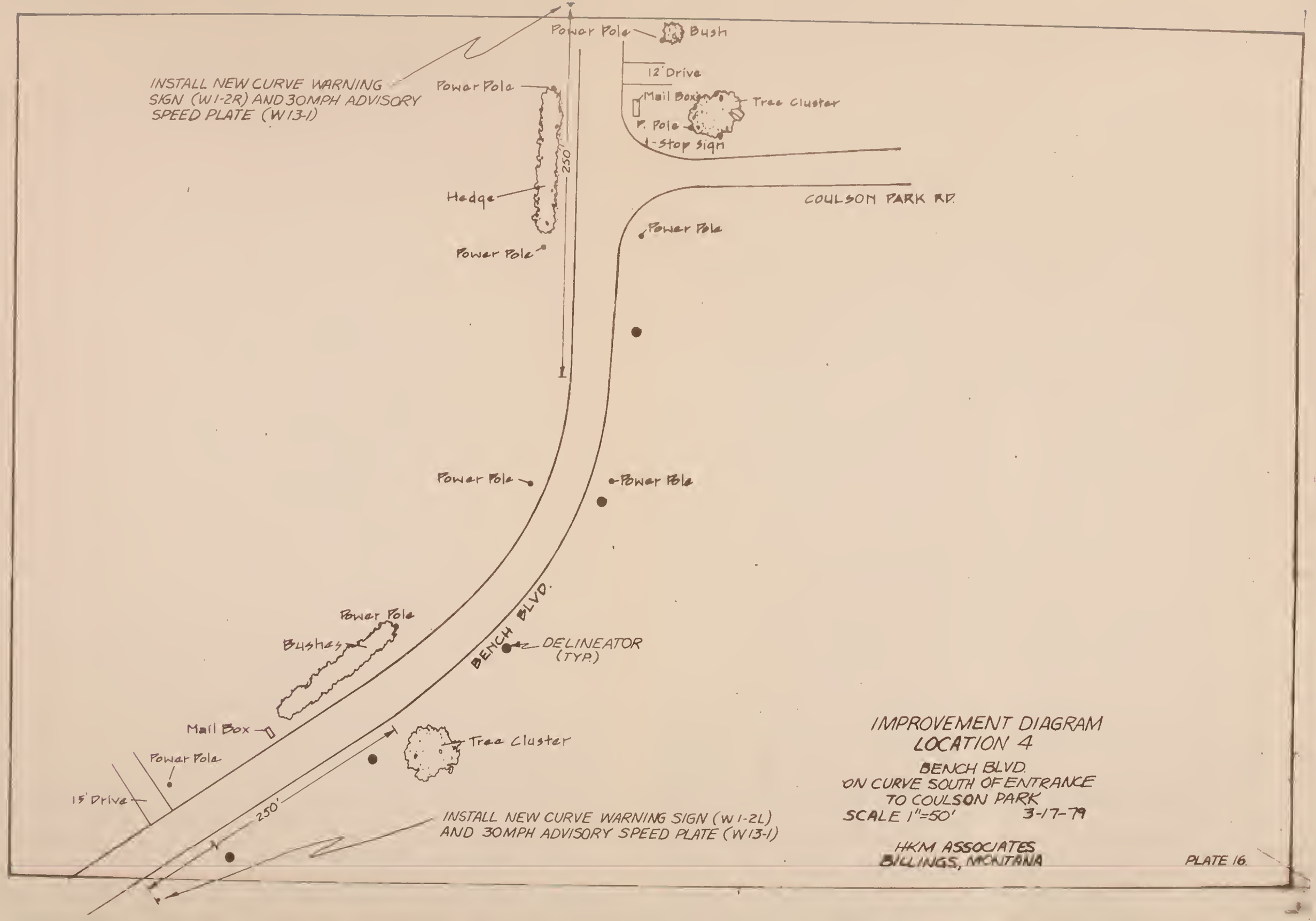


ACCIDENT DIAGRAM
LOCATION 4

BENCH BLVD.
ON CURVE SOUTH OF ENTERANCE
TO COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 15.



IMPROVEMENT DIAGRAM
LOCATION 4

BENCH BLVD.
ON CURVE SOUTH OF ENTRANCE
TO COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 16.

LOCATION NO. 5

This location is the intersection of Grand Avenue with 54th Street West.

Evaluation

This location is a "T" intersection. 54th Street West forms the stem of the "T" and is controlled by a stop sign. 1978 ADT at this location is as follows:

54th Street West ADT = 127 VPD
Grand Avenue ADT = 636 VPD

Four accidents were recorded during the study period. All were personal injury accidents. One occurred on wet pavement due to a vehicle dropping a wheel off a pavement edge in a section without shoulders. The other three involved southbound vehicles which ran or slid through the stop controlled intersection leg. These three all occurred on dry pavement at night.

The speed limit in this area is 35 mph. Safe operating speed does not appear to be a factor. The existing signing appears to have poor target value and tends to blend in with the background. Visibility at the stop sign on 54th Street West looking east is somewhat limited by a hedge and some trees. However this does not appear to be a factor in the accidents at this location.

Recommended Improvement

Our recommendation is to upgrade the existing signing and provide appropriate striping. Recommended signing includes the following:

- Install a new stop ahead sign (W3-1) on 54th Street West
- Replace the existing stop sign on 5th Street West with a new 36" stop sign (R1-1).

- Install new side road warning signs (W2-2) east and west of 54th Street West on Grand Avenue.

Estimated Cost of these improvements is $450.00.

SITE NUMBER 5 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
2	2	-

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	1	1	-	-	-	-	-	2	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	-	-	-	1	-	2

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	1	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	1	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK, UNLIGHTED
1	-	1	2

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	-	-	-	-	-	4	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
-	3	1	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
4	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	3	2	-
No. fatal.	-	-	-
No. P.D.O.	-	-	-

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 5 Date April 18, 1979

Site Description Grand Avenue at 54th Street West

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.283	=	9.06
Accident Rate	4.78 acc/MEV	65	x	0.388	=	25.22
Accident Severity	11,850 dollars	64	x	0.329	=	21.06
		Sums:		1.000*		55.34

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 8.41 $/1000 vehicles

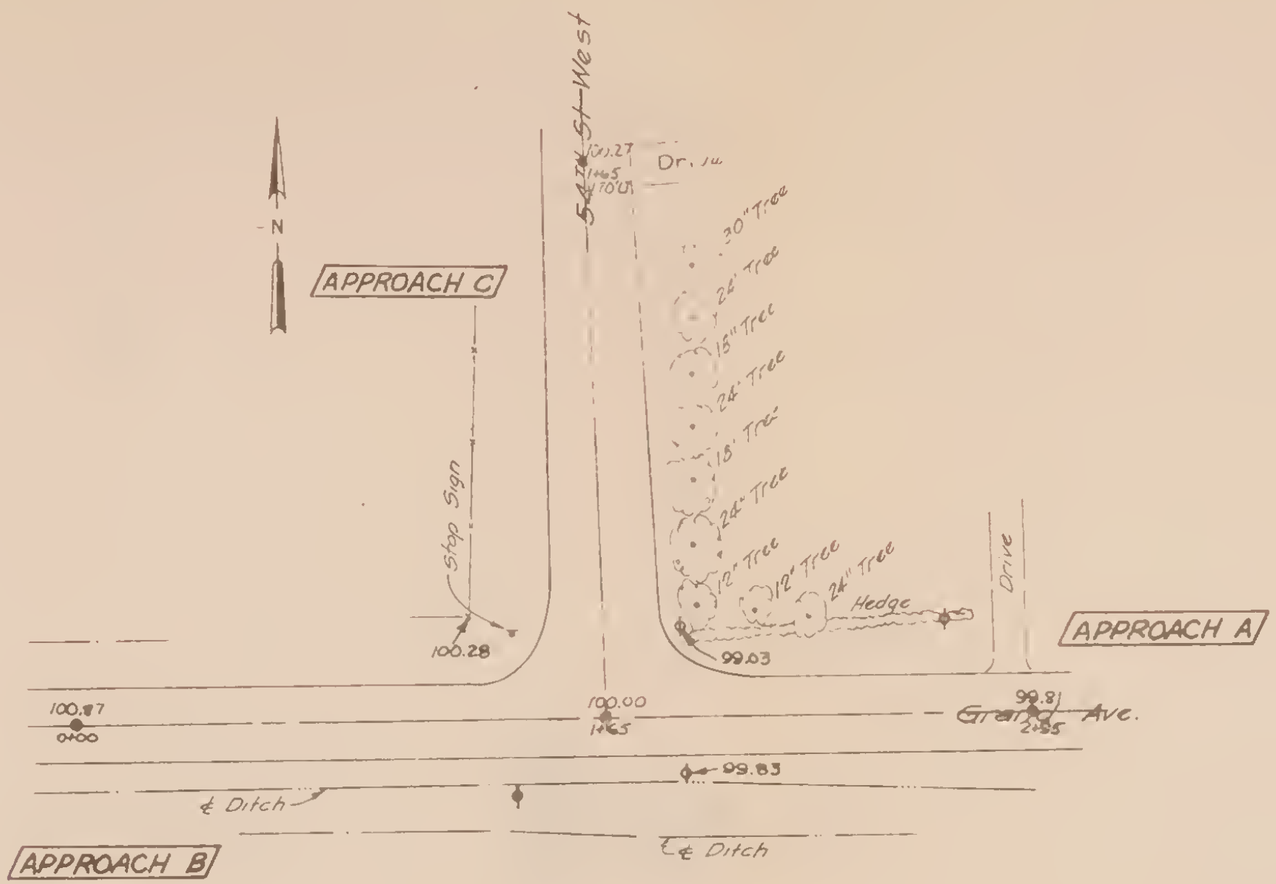
Cost Factor: 84

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 55.34 + 0.25 x 84

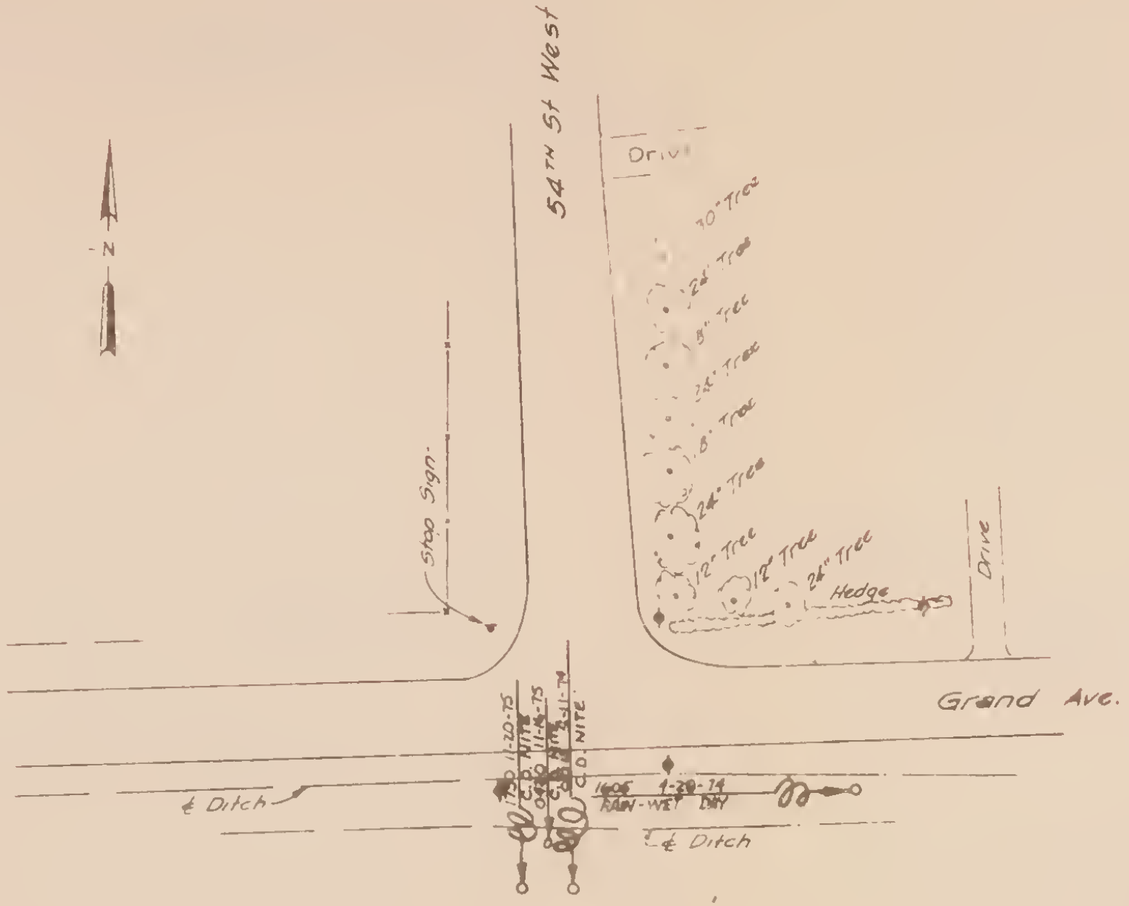
P.I. = 62.5



CONDITION DIAGRAM
LOCATION 5
INTERSECTION OF
GRAND AVE. WITH 54TH ST. WEST
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 17.

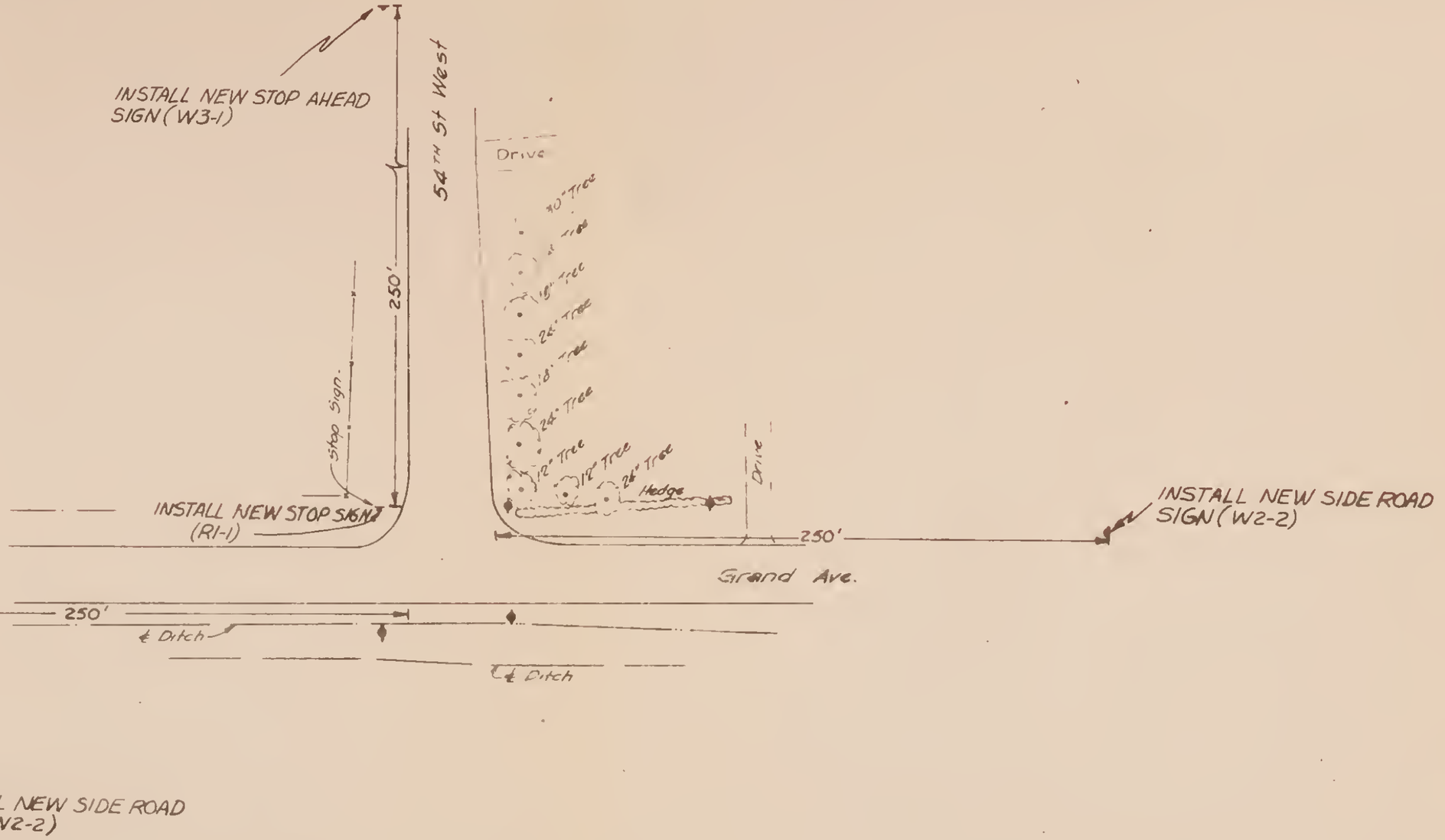


ACCIDENT DIAGRAM
LOCATION 5

INTERSECTION OF:
GRAND AVE. WITH 54 TH ST. WEST
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 18.



IMPROVEMENT DIAGRAM
LOCATION 5
INTERSECTION OF
GRAND AVE WITH 54TH ST. WEST
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 19.

LOCATION NO. 6

This location is on Bench Blvd. from Steffanich Drive to Birch Lane.

Evaluation

This location involves a 0.303 mile segment of Bench Blvd. 1978 ADT on this segment of road is 1322 vehicles per day.

Twelve accidents were reported during the study period. All were at isolated locations except at Dorothy Lane. Five of the accidents involved a single vehicle which left the road. Two involved vehicles backing out of driveways. Four involved rear end collisions. One accident involved an illegal passing maneuver.

The only apparent common factor appears to be driver error. The speed limit in this area is 35 mph. Sight distance in this area is adequate. There is no readily discernable engineering solution to reduce the accident occurence at this location. Therefore, no action is recommended.

SITE NUMBER 6 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
5	2	5

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	2	1	1	1	-	1	1	-	3	1	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	-	4	1	1	2	3

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
11	-	1	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
9	-	1	2	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
9	-	2	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	4	5	-	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
9	1	2	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
12	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	2	1	2
No. fatal.	-	-	-
No. P.D.O.	4	1	4

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 6 Date April 18, 1979

Site Description Bench Blvd. between Steffanich and Birch

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0 acc/yr	51	x	0.283	=	14.43
Accident Rate	8.29 acc/MEV	91	x	0.388	=	35.31
Accident Severity	3,342 dollars	38	x	0.329	=	12.50
		Sums:		1.00 *		62.24

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

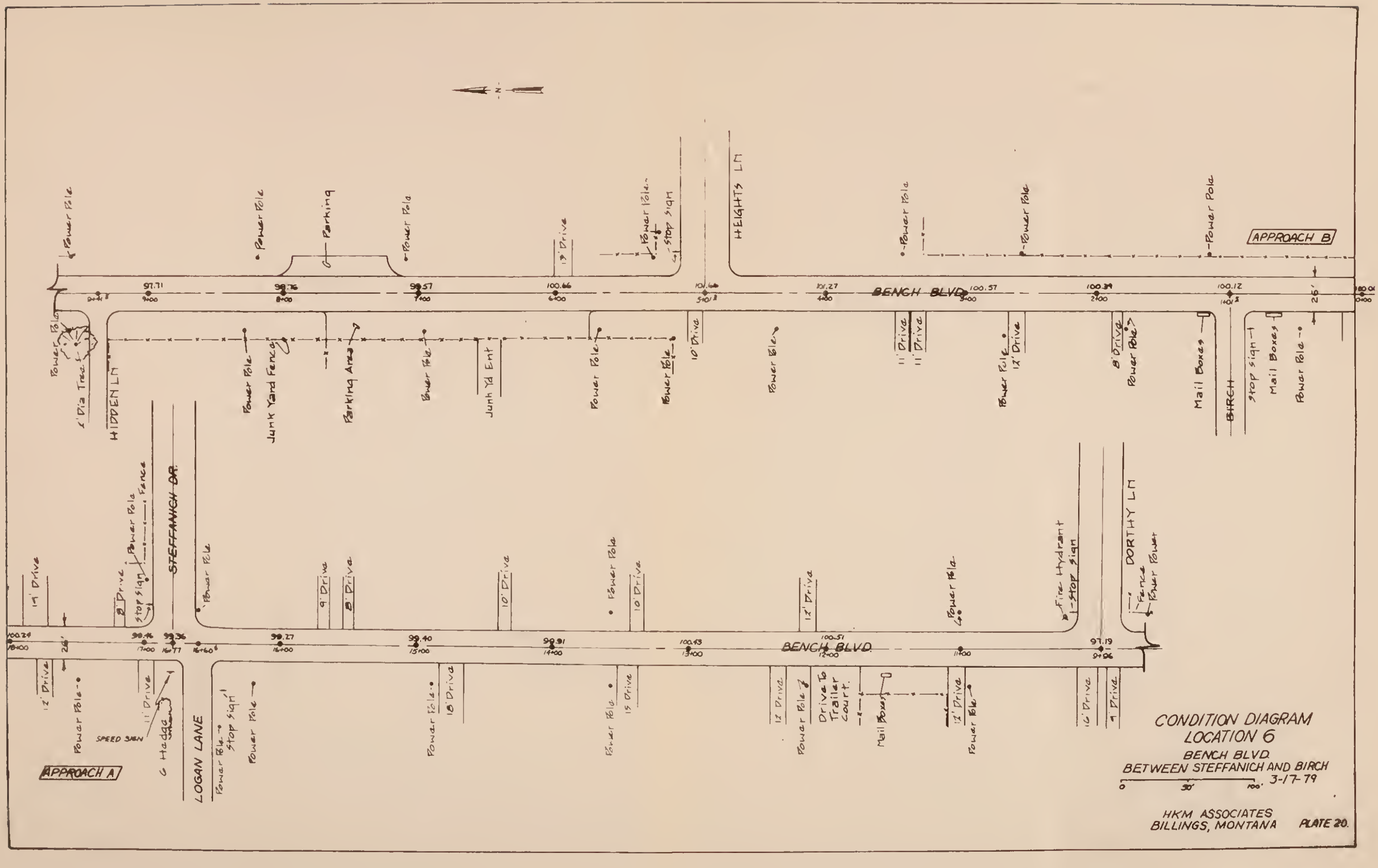
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

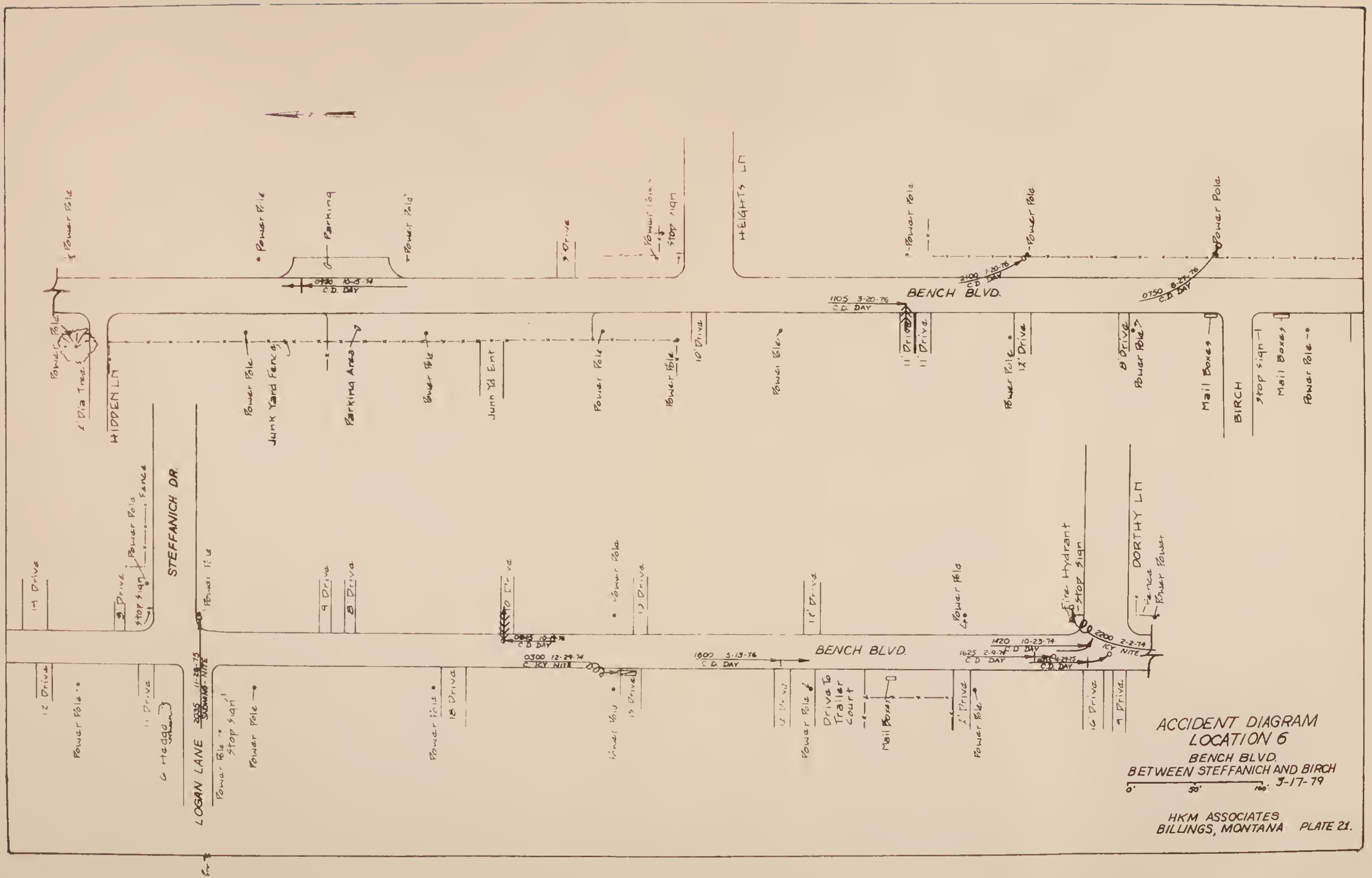


CONDITION DIAGRAM
LOCATION 6
BENCH BLVD.
BETWEEN STEFFANICH AND BIRCH
3-17-79

0 50' 100'

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 20.


BENCH BLVD.
HEIGHTS LN
HIDDEN LN
STEFFANICH DR.
LOGAN LANE
BIRCH
DORTHY LN
Power Pole
Parking
Junk Yard Fence
Parking Area
Junk Yd Entr
Power Pole
Power Pole
10' Drive
Power Pole
Power Pole
Power Pole

LOCATION NO. 7

This location is the curve on Old Chicago Road just north of U.S. 312.

Evaluation

The area of interest at this location is a sharp curve. 1978 ADT is 218 vehicles per day.

Initial data indicated ten accidents at this location. When accident reports were reviewed, it was determined that two were not at this location but had been misplotted on the original accident spot maps. Five other accidents occurred away from the curve and had no connection with the curve. Three of these involved livestock.

Three accidents appear related to the curve. All Hazard Index parameters were therefore evaluated using this adjusted figure. All three accidents involved vehicles leaving the roadway. The roadway surface was dry in all cases.

Existing curve data are as follows:

Δ = 45° 30'
E = 23 ft. $\pm$
T = 144 ft. $\pm$
R = 343 ft.
e = 0.055 ft./ft.

Safe driving speed is determined to be 32.5 mph.

The posted speed limit is 35 mph. Sight distance is adequate in this area.

Recommended Improvement

Our recommendation is to upgrade the existing signing by adding an eastbound curve warning sign (W1-1) with a 30 mph speed advisory plate (W13-1). It is also recommended that a 30 mph speed advisory plate (W13-1) be added to the existing westbound curve warning sign. Estimated cost of these improvement is $150.00.

SITE NUMBER 1 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
4	4	2

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	-	1	1	2	1	4	-	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	-	-	-	4	6

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
8	1	-	1	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
8	1	-	1	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
3	-	-	7

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	-	3	-	-	-	3	-	3

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
7	3	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
10	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	1	1
No. fatal.	-	-	-
No. P.D.O.	3	3	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 7 Date April 18, 1979

Site Description Curve on Old Chicago Road just north of U.S. 312

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.283	=	7.36
Accident Rate	12.5 acc/MEV	100	x	0.388	=	38.80
Accident Severity	12,400 dollars	65	x	0.329	=	21.39
		Sums:		1.000*		67.55

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.34 $/1000 vehicles

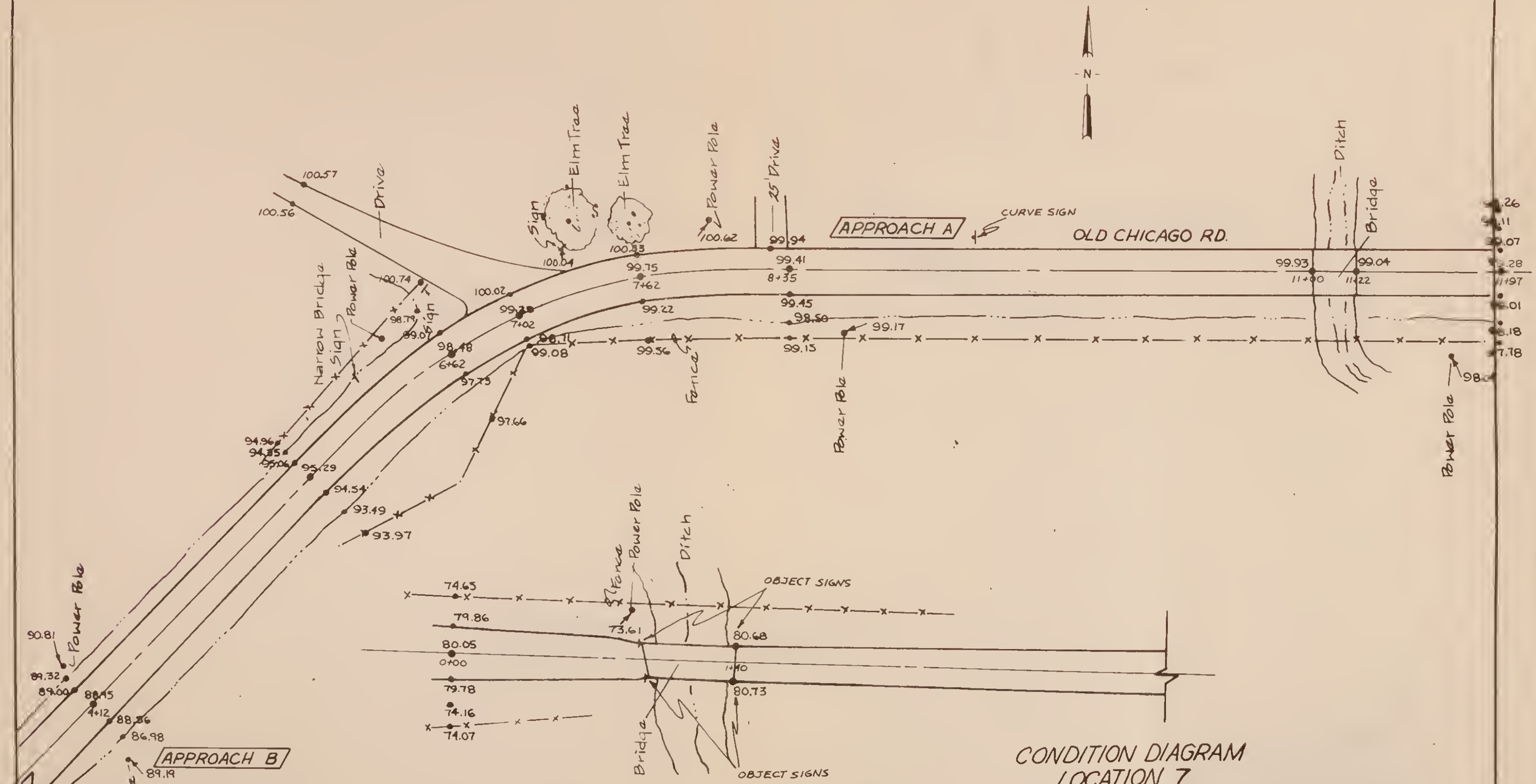
Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 67.55 + 0.25 x 100

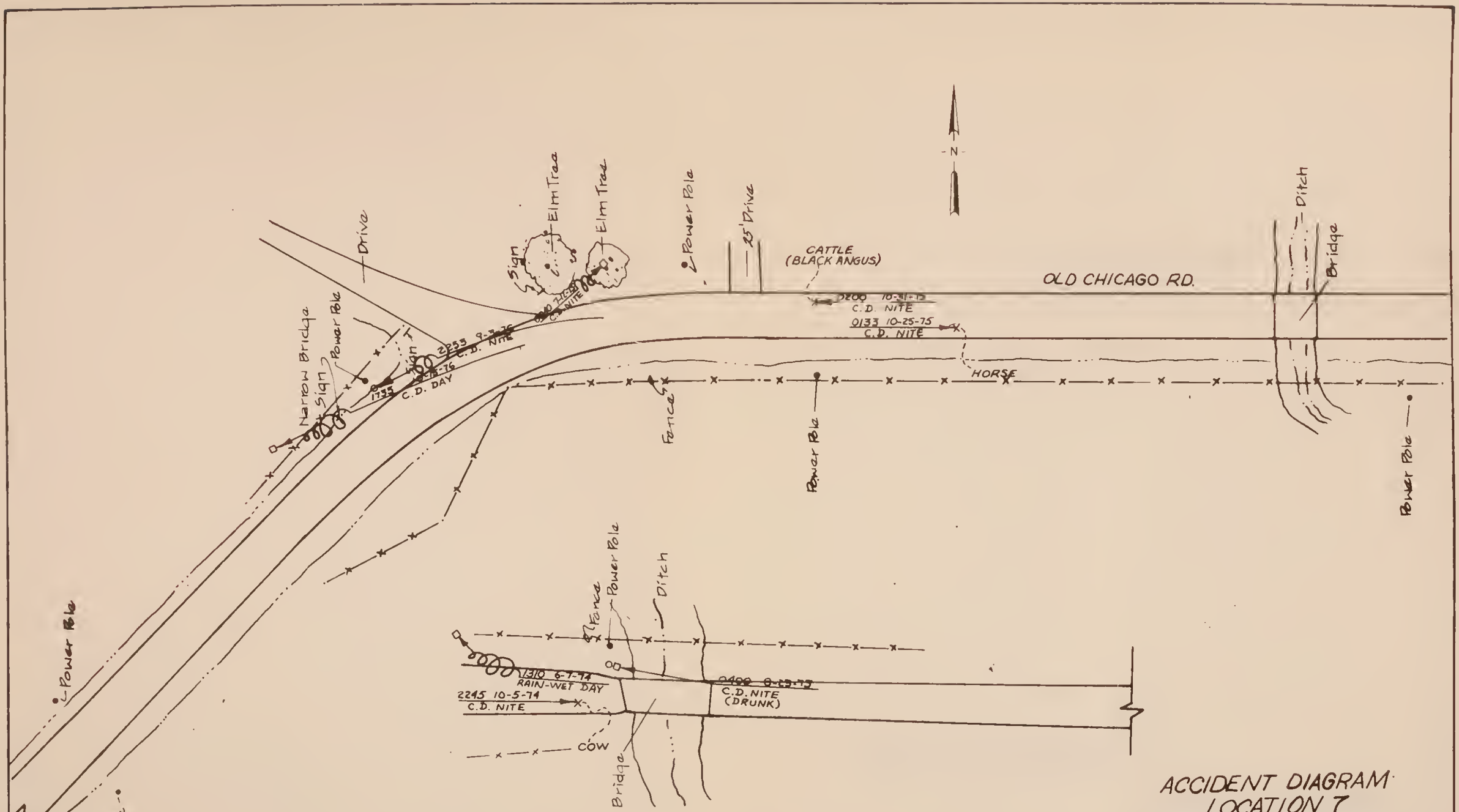
P.I. = 75.7



CONDITION DIAGRAM
LOCATION 7
CURVE ON OLD CHICAGO ROAD
JUST NORTH OF USH 312
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

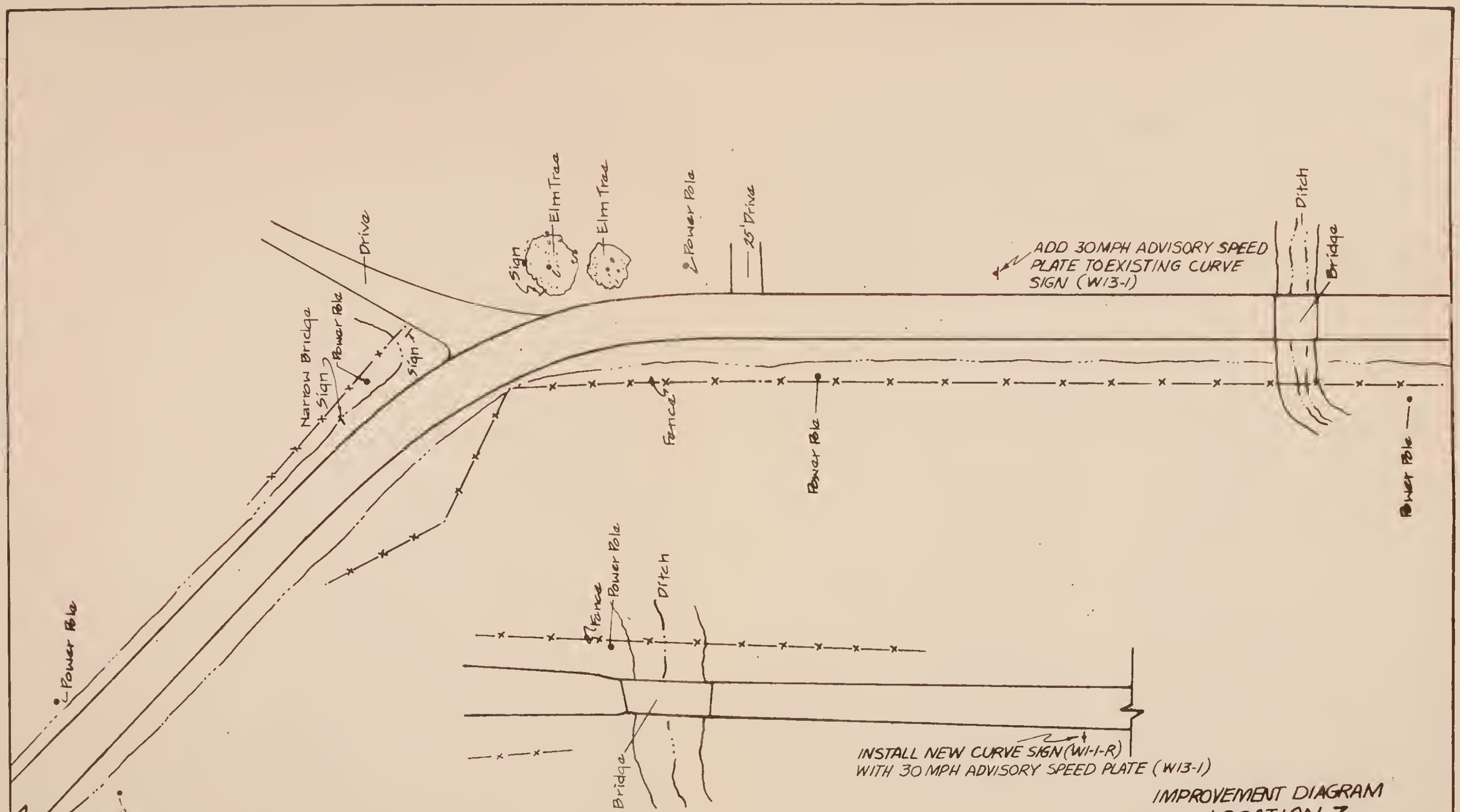
PLATE 22.



ACCIDENT DIAGRAM
LOCATION 7

CURVE ON OLD CHICAGO ROAD
JUST NORTH OF USH 312
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA PLATE 23.



IMPROVEMENT DIAGRAM
LOCATION 7

CURVE ON OLD CHICAGO ROAD
JUST NORTH OF USH 312

SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA PLATE 24.

LOCATION NO. 8

This location is McGirl Road just east of U.S. 312.

Evaluation

The section of McGirl Road under consideration is a straight alignment. A factor contributing to the traffic volume and accident occurrence on this road is that it serves Belaro Speedway. 1978 ADT at this location is 3395 vehicles per day.

Seven accidents were reported at this location during the study period. Three of these were rear end collisions which appear to have involved the Speedway. The other accidents appear to be the result of weather or driver error.

The speed limit in this area is 55 mph. Sight distance is adequate. No action is recommended at this time. However, this location should be monitored. As development occurs in this area, upgrading of the facility will become necessary.

SITE NUMBER 8 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
-	2	5

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	1	-	-	4	1	-	-	1	-	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
3	1	-	1	2	-	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
4	-	-	-	3

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
6	-	1	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
4	-	-	3

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	3	3	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
4	2	1	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
7	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	1	3
No. fatal.	-	-	-
No. P.D.O.	-	1	3

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 8 Date April 18, 1979

Site Description McGirl Road just east of U.S. 312

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33 acc/yr	40	x	0.283	=	11.33
Accident Rate	1.88 acc/MEV	31	x	0.388	=	12.04
Accident Severity	9,614 dollars	58	x	0.329	=	19.08
		Sums:		1.000*		42.45

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

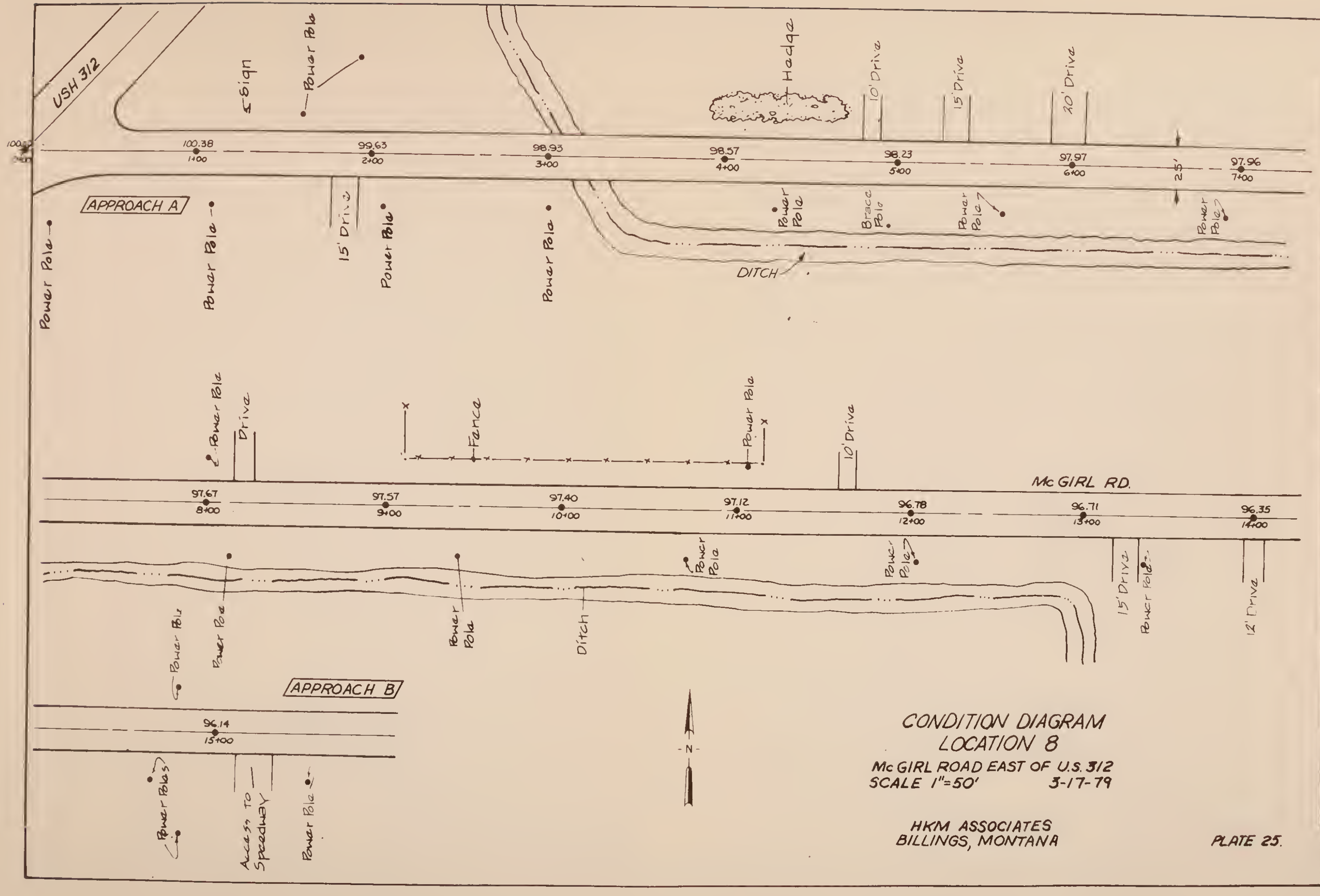
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

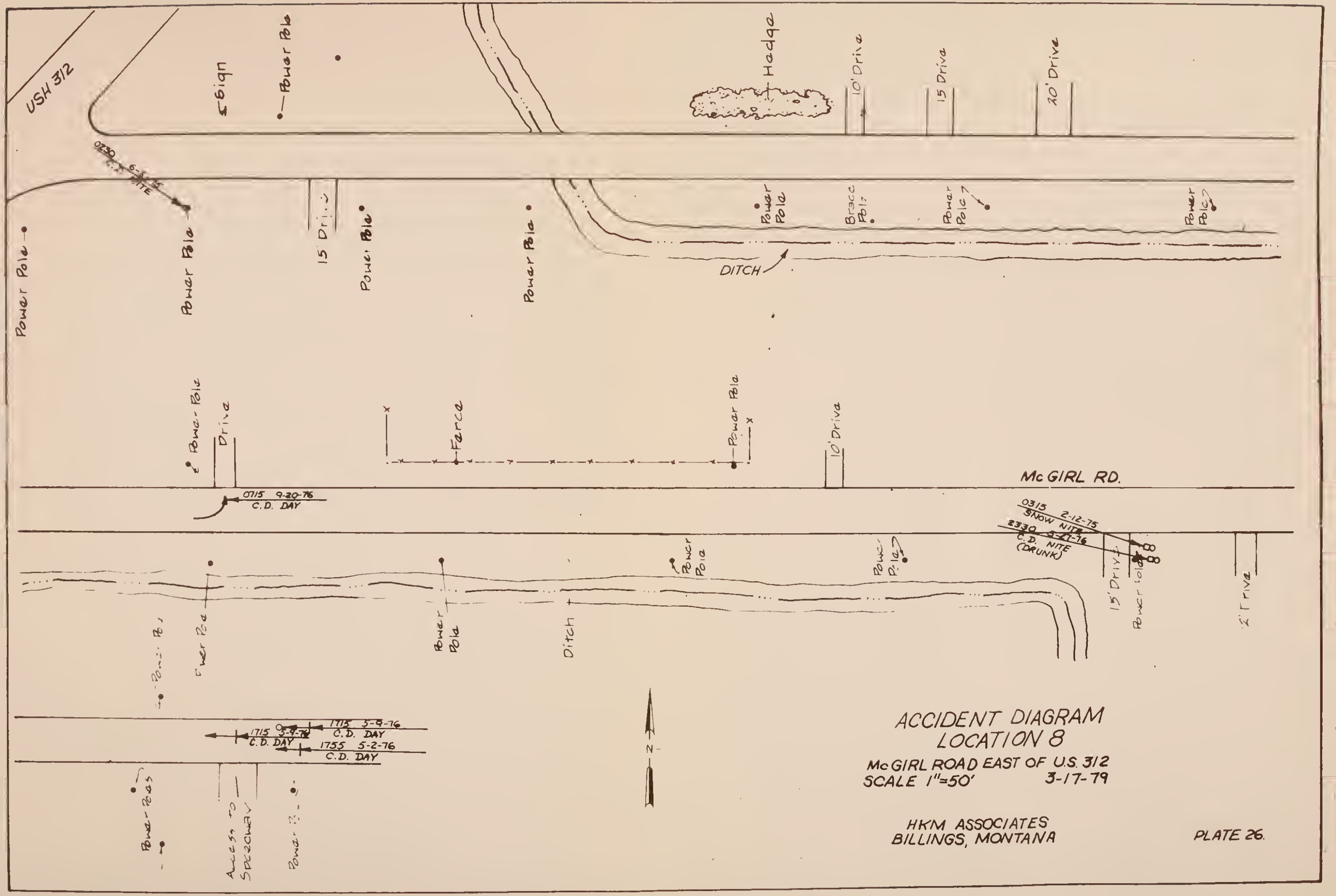


CONDITION DIAGRAM
LOCATION 8

McGIRL ROAD EAST OF U.S. 312
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 25.



ACCIDENT DIAGRAM
LOCATION 8

McGIRL ROAD EAST OF U.S. 312
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 26.

LOCATION NO. 9

This location is the intersection of Piccolo Lane with Old Hardin Road.

Evaluation

Piccolo Lane forms a "Y" intersection with Old Hardin Road. ADT at this location is as follows:

Old Hardin Road ADT = 4536 VPD
Piccolo Lane ADT = 449 VPD

Three accidents were reported during the study period. All were attributable to driver error, i.e., speeding, improper turn, failure to clear frost from windows.

Across the intersection on the north side of Old Hardin Road is an extremely wide uncontrolled drive approach. The Lockwood Superette is located in the southwest quadrant of the intersection. This store has continuous drive approaches along both road frontages. It is apparent that many turning movements are being made through the Superette parking area. Sight distance at the intersection is adequate.

No action is recommended at this time. An annual review of this location will be essential because of the rapid growth in the Lockwood area. At some point in the future the approaches to the Lockwood Superette will have to be defined and controlled. In addition some channelization or realignment of the intersection may become necessary.

SITE NUMBER 9 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	2	-

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	-	-	2	-	-	-	-	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	-	1	-	1	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
3	-	-	-

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
2	-	1	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
1	1	1	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
3	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	2	-
No. fatal.	-	-	-
No. P.D.O.	-	1	-

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 9 Date April 18, 1979

Site Description Intersection of Piccolo Lane and Old Hardin Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.283	=	7.37
Accident Rate	0.55 acc/MEV	10	x	0.388	=	3.88
Accident Severity	13,433 dollars	68	x	0.329	=	22.37
		Sums:		1.000*		33.62

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

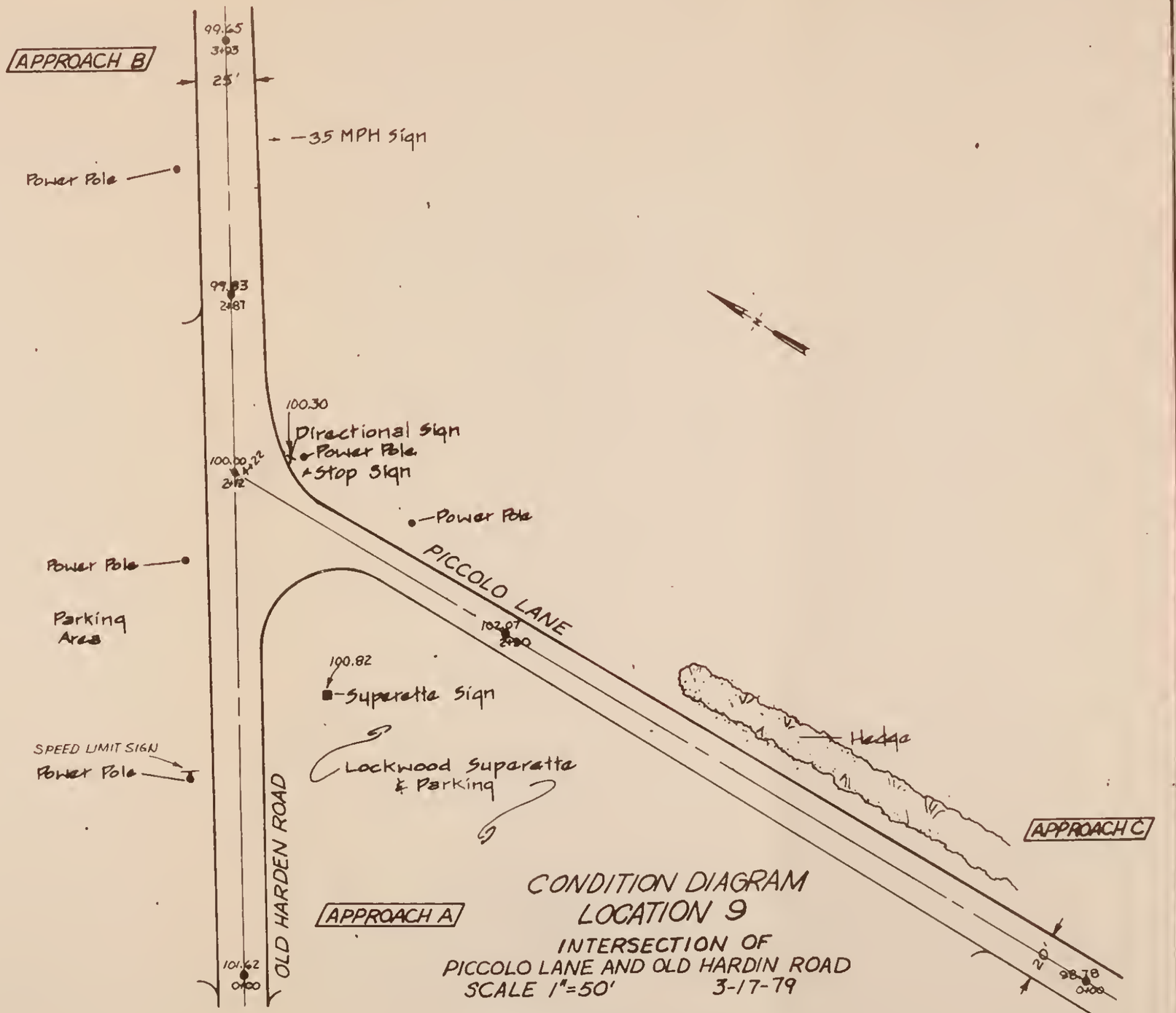
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

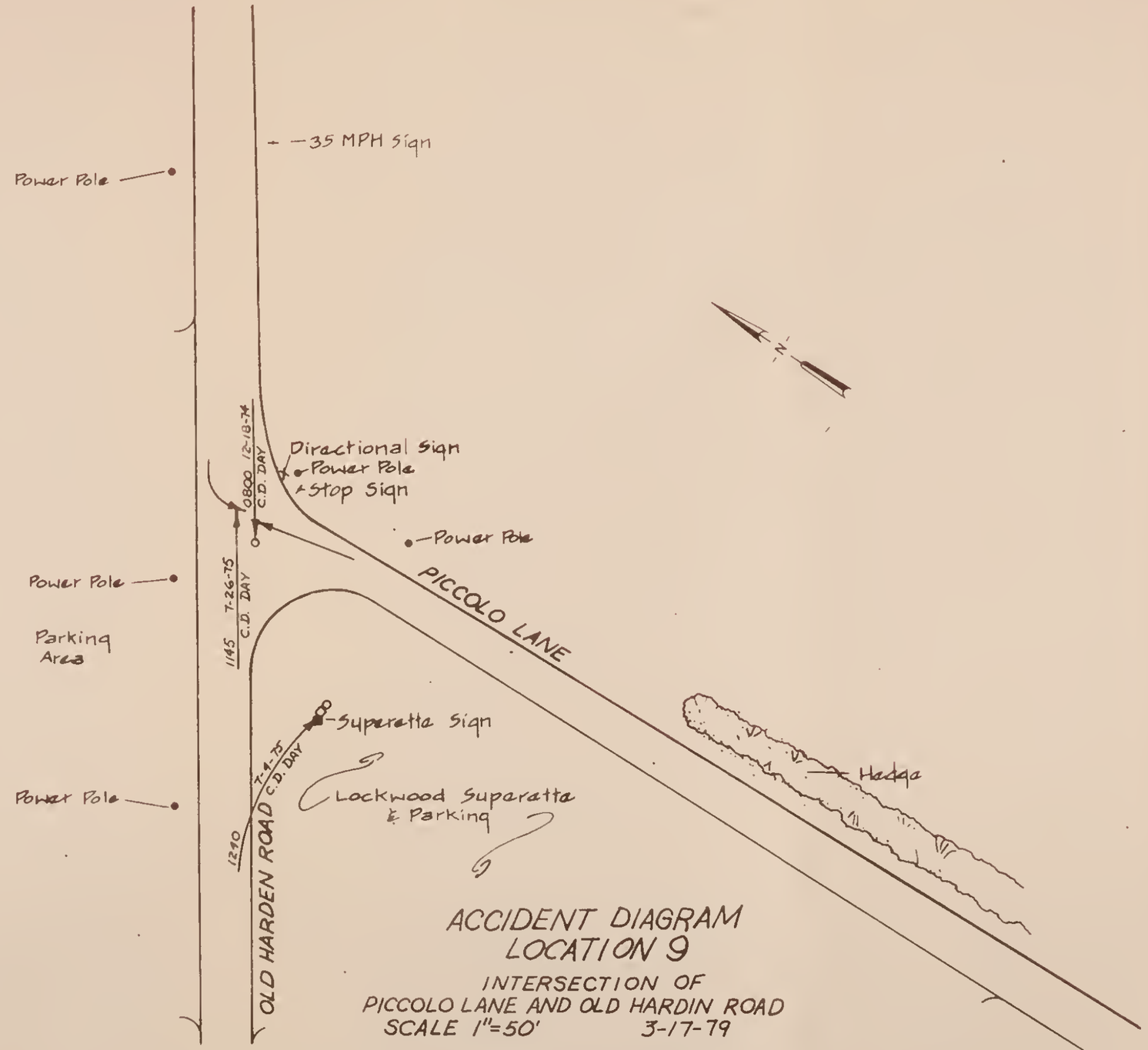
P.I. = N/A



CONDITION DIAGRAM
LOCATION 9
INTERSECTION OF
PICCOLO LANE AND OLD HARDIN ROAD
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 27.



ACCIDENT DIAGRAM
LOCATION 9

INTERSECTION OF
PICCOLO LANE AND OLD HARDIN ROAD
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 28.

LOCATION NO. 10

This location is the intersection of Refinery Road with Lockwood Road.

Evaluation

Refinery Road serves as the main entrance to the Exxon Refinery. Lockwood Road is a local road serving land access west of the refinery. 1978 ADT at this location is as follows:

Refinery Road ADT = 491 VPD
Lockwood Road ADT = 307 VPD

Two accidents were reported at this location during the study period. Both were personal injury accidents. One involved a rear end collision and the other was a result of driver error on an icy road surface.

High ground in the southwest corner of the intersection restricts sight distance for eastbound vehicles at the stop sign. The railroad tracks on the north side of Lockwood Road also limit sight distance to less than desirable.

Due to the nature of the accidents, no apparent engineering treatment is evident. No action is recommended at this time.

SITE NUMBER 10 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	-	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	1	-	-	-	-	-	1	-	-	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	-	1	1	-	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
2	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
1	-	-	1	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
2	-	-	-

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	1	-	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
-	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
2	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	-	1
No. fatal.	-	-	-
No. P.D.O.	-	-	-

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 10 Date April 18, 1979

Site Description Intersection of Lockwood Rd. with Refinery Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	0.67 acc/yr	21	x	0.283	=	5.94
Accident Rate	2.3 acc/MEV	37	x	0.388	=	14.36
Accident Severity	9,800 dollars	59	x	0.329	=	19.42
		Sums:		1.000*		39.72

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

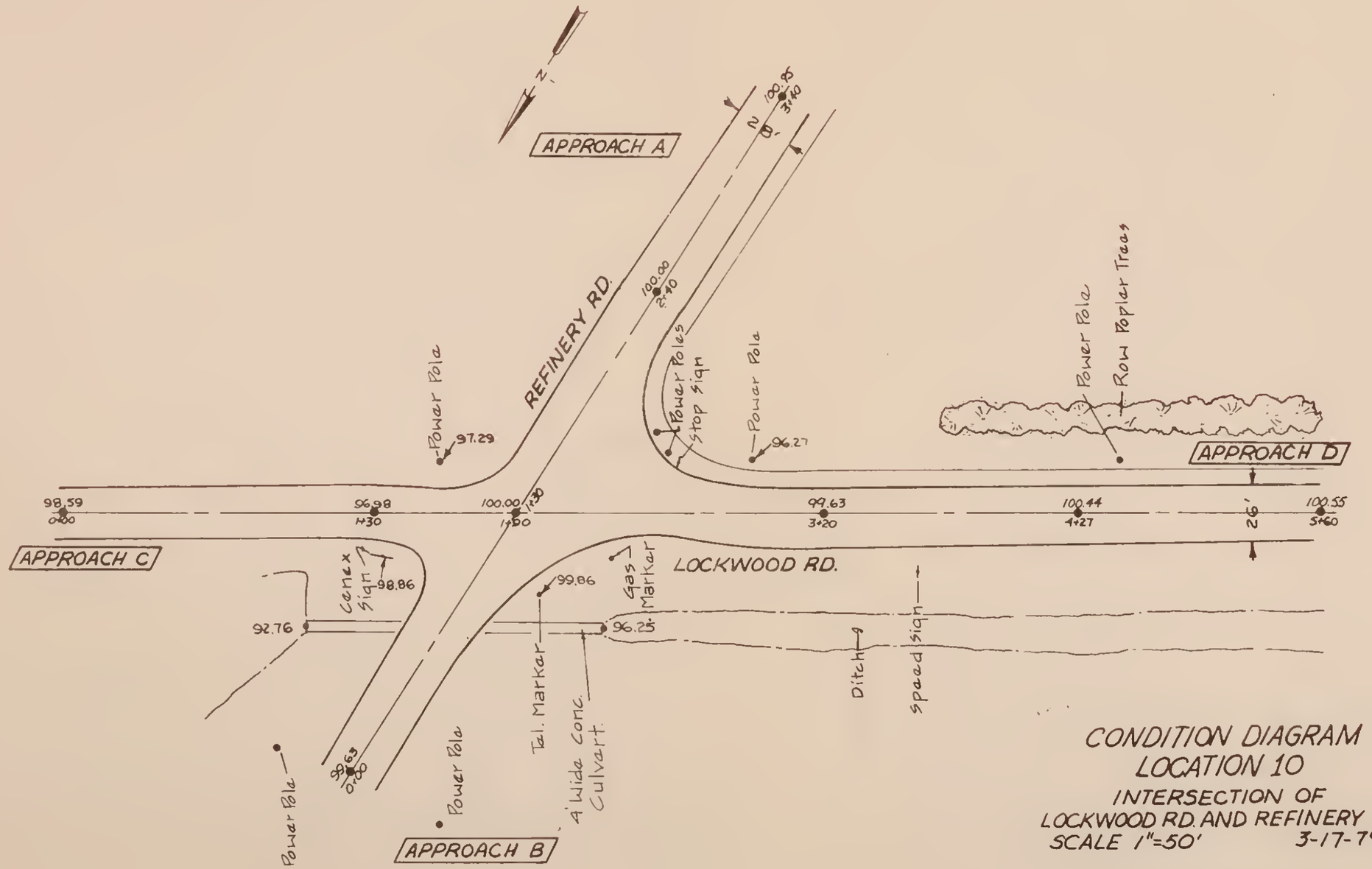
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

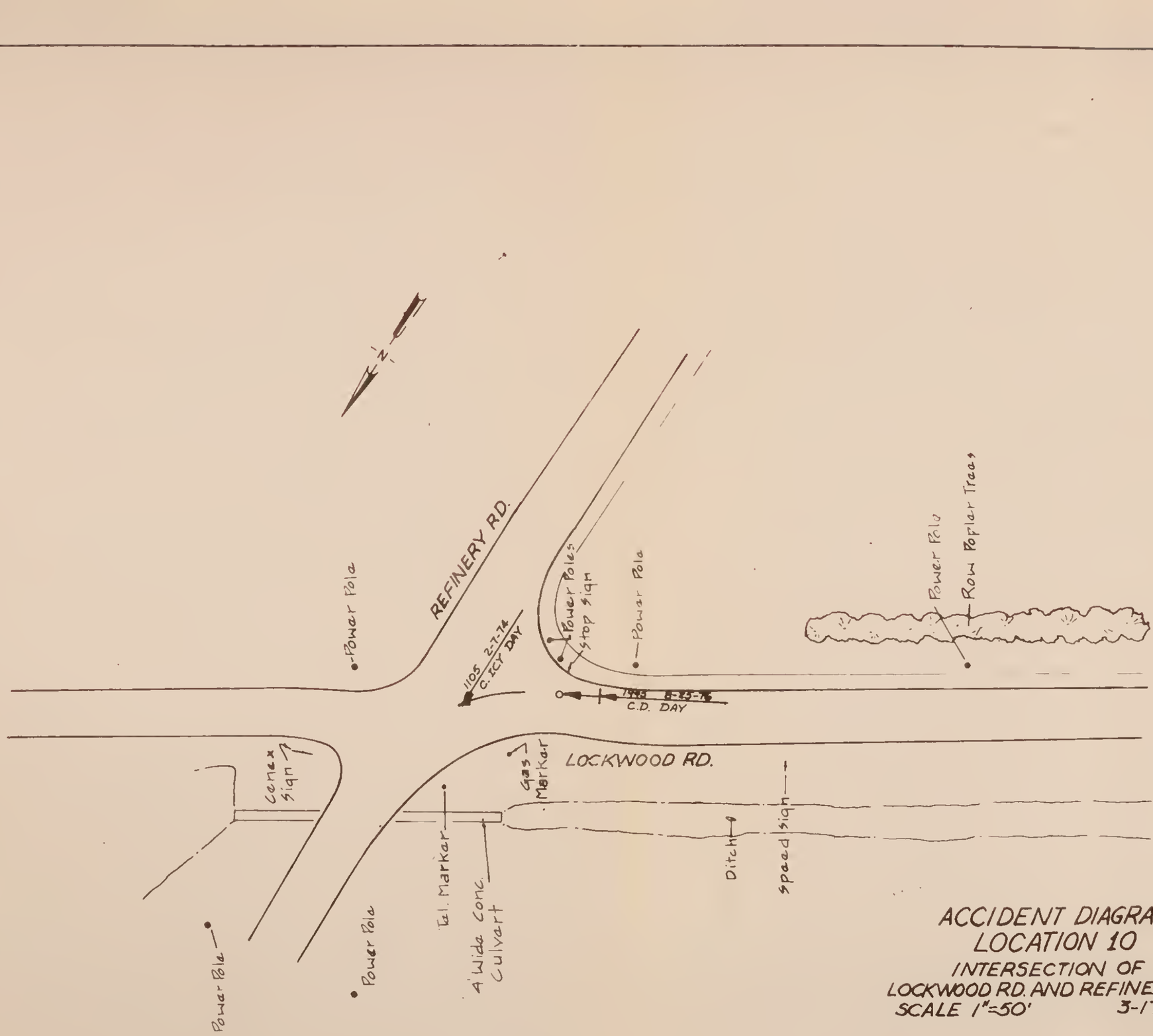


CONDITION DIAGRAM
LOCATION 10

INTERSECTION OF
LOCKWOOD RD. AND REFINERY RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 29.



ACCIDENT DIAGRAM
LOCATION 10
INTERSECTION OF
LOCKWOOD RD. AND REFINERY RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 30.

LOCATION NO. 11

This location is the intersection of Wicks Lane and Bench Blvd.

Evaluation

This location is a four-way stop controlled intersection. Wicks Lane is an arterial route and Bench Blvd. is a collector route. All legs of the intersection are two lane with a twenty four foot top. 1978 ADT at this location are as follows:

Wicks Lane ADT = 5985 VPD
Bench Blvd. ADT = 1350 VPD

Twelve accidents were reported at this location during the study period. Seven of these involved rear end collisions, four were angle collisions, and one involved a parked vehicle. Nine of these accidents were attributable to icy road conditions. It is our feeling that the accidents were predominantly a result of driver error under adverse conditions.

Sight distance does not appear to be a problem at this location. The existing paving is in very poor condition with many chuckholes and is very rough. The speed limit is 35 mph on all approaches.

Recommendations

Removal of the stop signs was considered on Wicks Lane as this route has over four times the traffic volume as Bench Blvd. However, sight distance then becomes a problem because of weeds, grass, and trees. Also the stop signs do benefit the school crossing at this location.

Because Wicks Lane is a major arterial, it should be given early priority for sanding operations. Also, consideration should be

given to placing an adequate pavement section at this location as the existing pavement has totally failed.

No engineering solution for the problems at this location are apparent due to the predominant nature of the accidents. However, this location should be monitored annually.

SITE NUMBER 11 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	8	3

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
3	7	1	-	-	-	-	-	1	1	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	2	1	-	3	5	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
6	1	3	-	2

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
1	2	-	9	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
8	-	-	4

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
5	7	-	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
10	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
12	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	2	-
No. fatal.	-	-	-
No. P.D.O.	1	6	3

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 11 Date April 18, 1979

Site Description Intersection of Bench Blvd. with Wicks Lane

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0 acc/yr	51	x	0.283	=	14.43
Accident Rate	1.49 acc/MEV	25	x	0.388	=	9.70
Accident Severity	3,783 dollars	41	x	0.329	=	13.49
		Sums:		1.000*		37.62

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

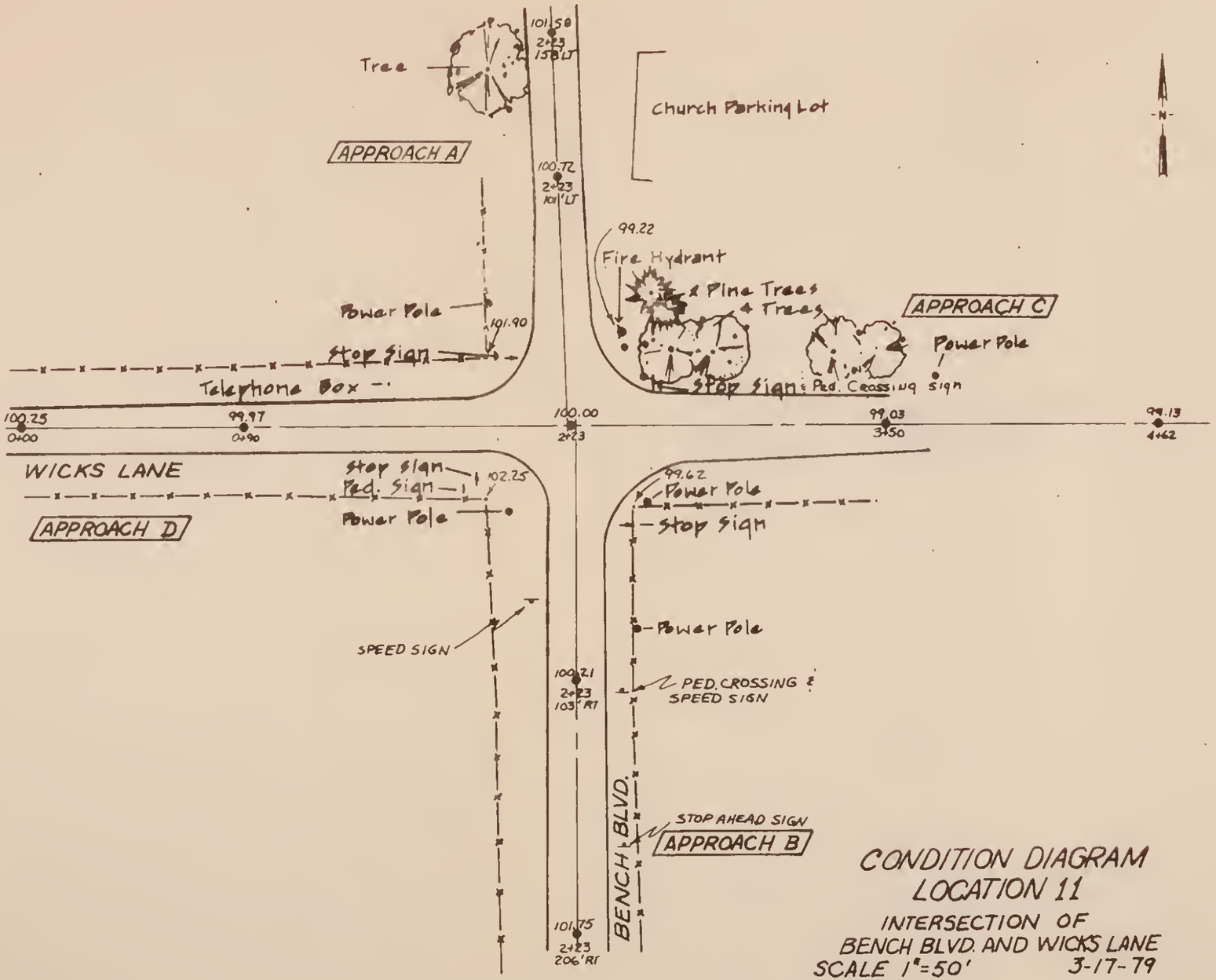
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

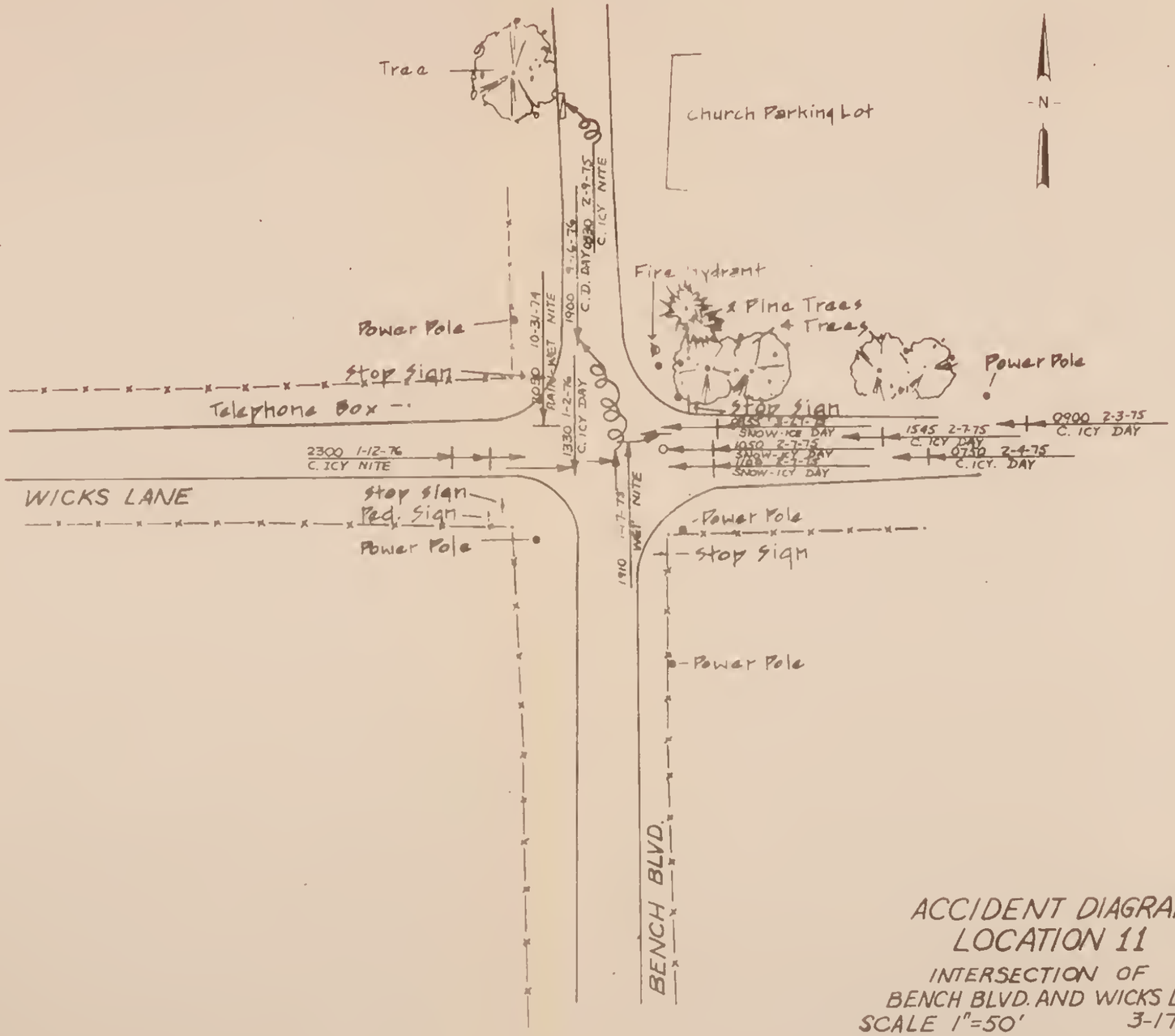


CONDITION DIAGRAM
LOCATION 11

INTERSECTION OF
BENCH BLVD. AND WICKS LANE
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 31.



ACCIDENT DIAGRAM
LOCATION 11

INTERSECTION OF
BENCH BLVD. AND WICKS LANE
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 32.

LOCATION NO. 12

This location is the "S" curve on the road to the City dump just west of Blue Creek Road.

Evaluation

The section under study consists of two curves immediately west of Blue Creek Road. The first curve proceeding west is less severe than the second curve. These will be identified as curves 1 and 2 respectively. 1978 ADT at this location is 1584 vehicles per day.

Four accidents were reported at this location during the study period. Three of these occurred on curve 1 and involved vehicles leaving the roadway. All three occurred on dry pavement. One accident occurred on curve 2 but was attributable to icy road conditions.

Existing curve data are as follows:

Curve 1		Curve 2	
Δ	= 30° 03'	Δ	= 71° 46'
T	= 178 ft. $\pm$	T	= 200 ft. $\pm$
R	= 663 ft.	R	= 276 ft.
e	= 0.035 ft./ft.	e	= 0.052 ft./ft.

Safe driving speed for curve 1 is 43 mph. Safe driving speed for curve 2 is 29 mph.

Sight distance at this location is severely restricted by trees and brush on the inside of these curves, particularly with curve 2. The speed limit at this location is 35 mph.

Recommended Improvements

Our recommendation is to remove trees and brush from the inside of the curves to provide maximum sight distance. It is also recommended that 25 mph advisory speed plates (W13-1) be added to the existing curve warning signs and that delineators be added through the curves.

Estimated cost of these improvements is $3500.00.

SITE NUMBER 12 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
2	1	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	-	-	-	1	1	-	1	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	2	-	-	-	-	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	-	-	-	1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	-	-	1	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK, UNLIGHTED
3	-	-	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	-	1	-	-	-	2	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
2	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
4	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	-	1
No. fatal.	-	-	-
No. P.D.O.	1	1	-

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 12 Date April 18, 1979

Site Description Curve on Road to City Dump just west of Blue Creek Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.283	=	9.07
Accident Rate	2.3 acc/MEV	37	x	0.388	=	14.37
Accident Severity	14,200 dollars	69	x	0.329	=	22.70
		Sums:		1.00 *		46.14

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 1.12 $/1000 vehicles

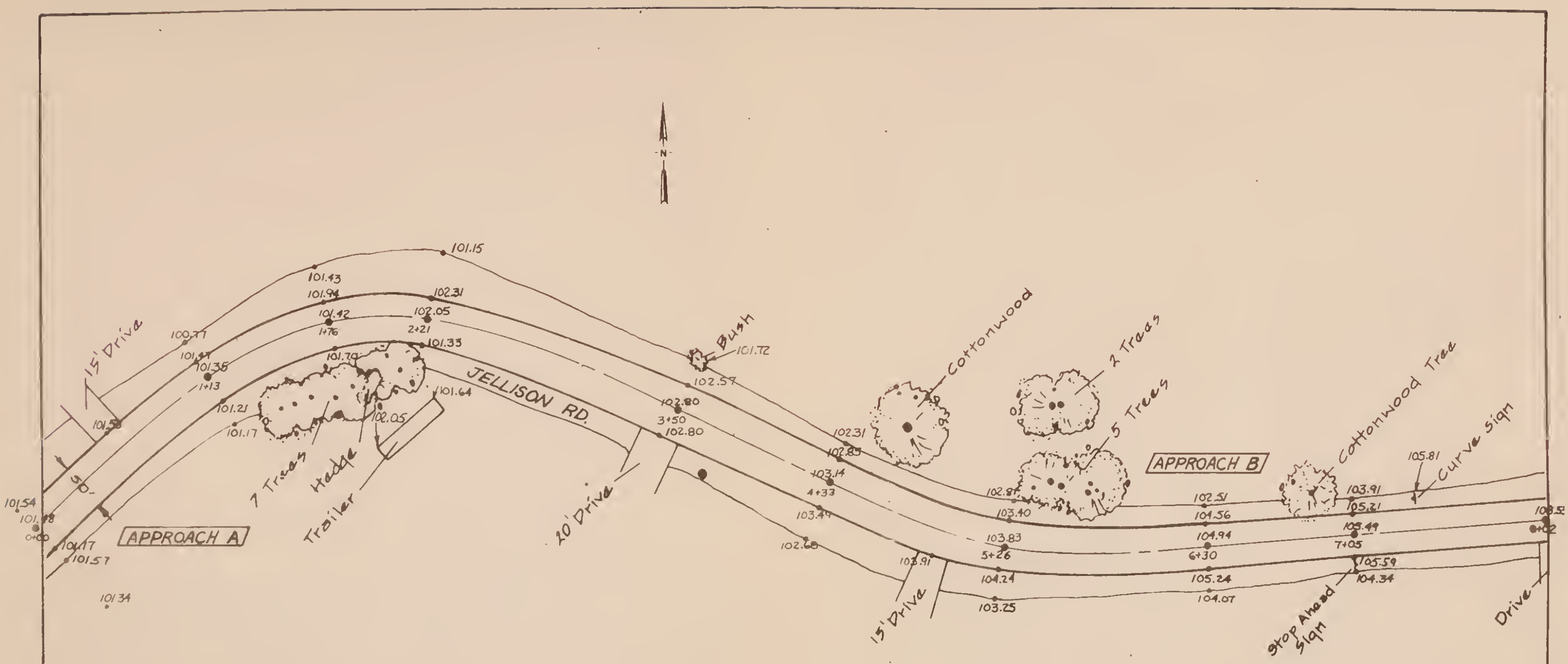
Cost Factor: 97

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 46.14 + 0.25 x 97

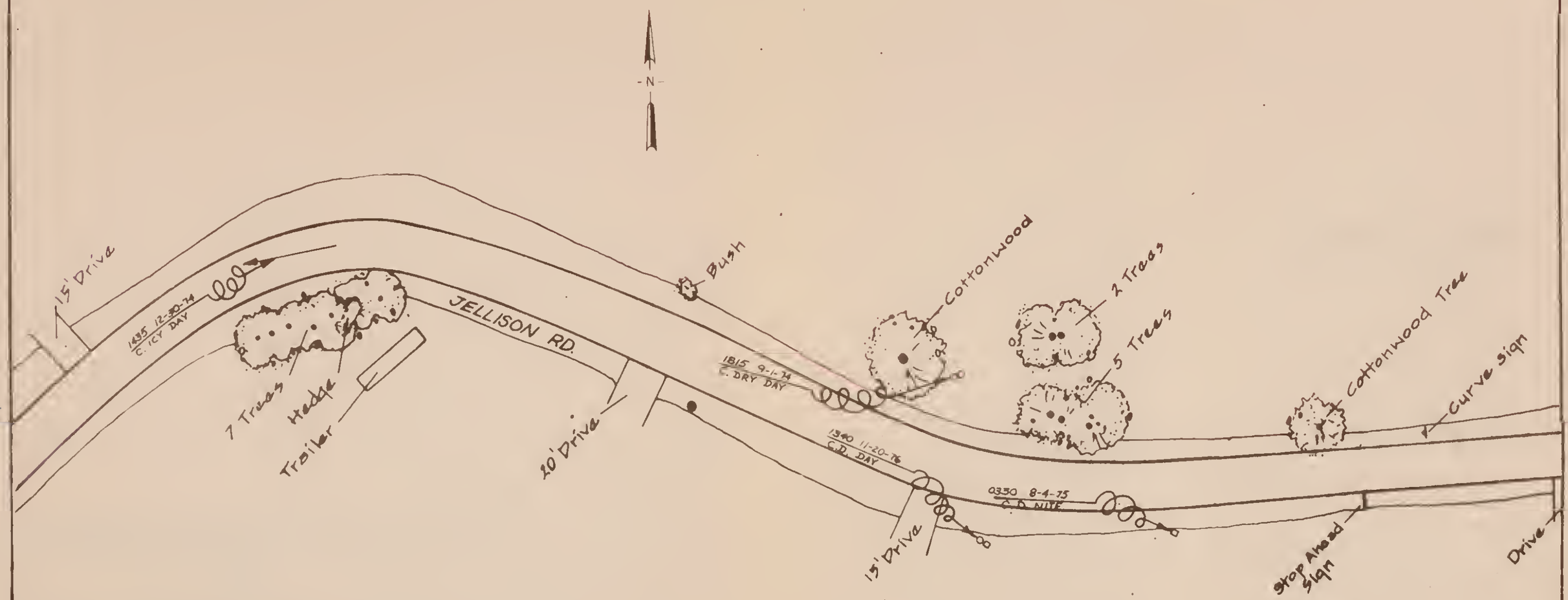
P.I. = 58.8



CONDITION DIAGRAM
LOCATION 12
CURVE ON ROAD TO CITY DUMP
JUST WEST OF BLUE CREEK RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 33.

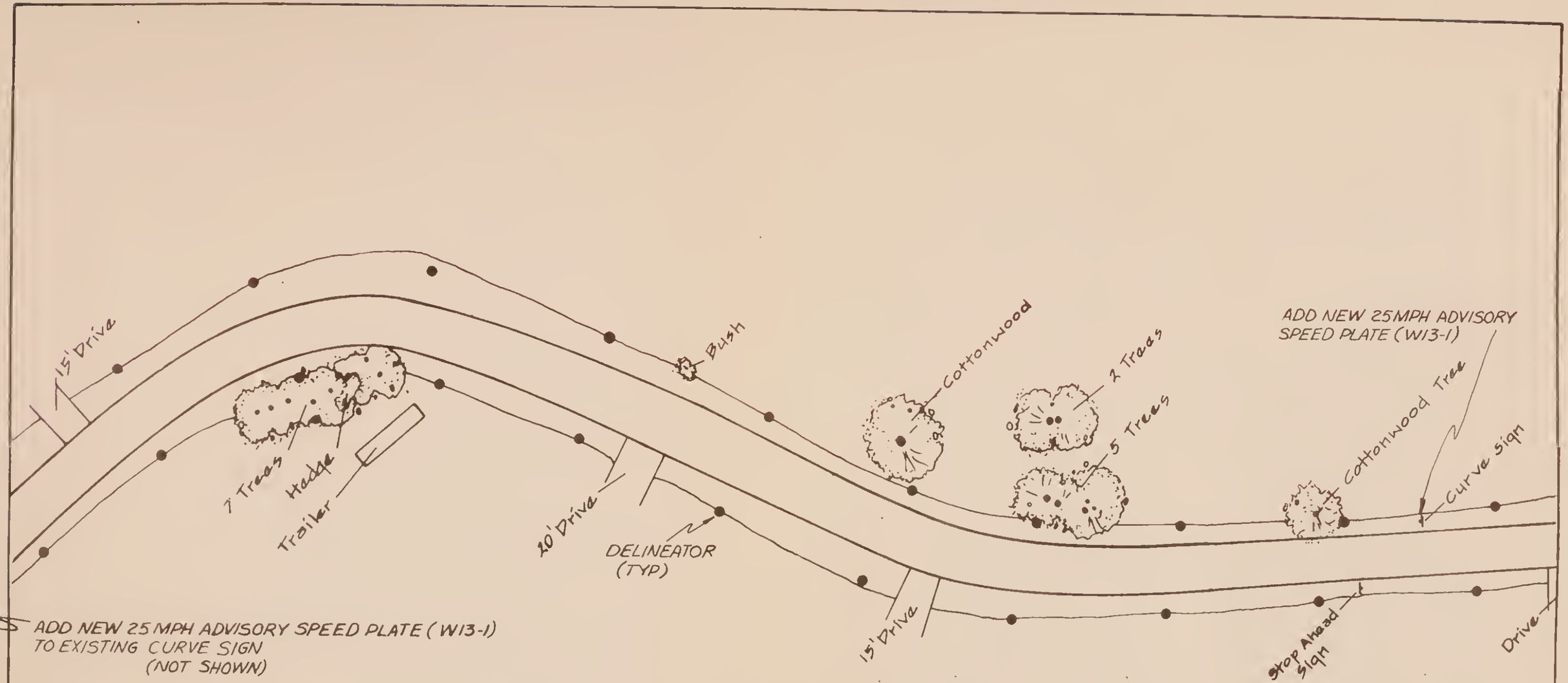


ACCIDENT DIAGRAM
LOCATION 12

CURVE ON ROAD TO CITY DUMP
JUST WEST OF BLUE CREEK RD.
SCALE 1"=50' 5-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 34.



ADD NEW 25 MPH ADVISORY SPEED PLATE (W13-1)
TO EXISTING CURVE SIGN
(NOT SHOWN)

INSTALL DELINEATORS ON BOTH SIDES OF ROAD AT
75 FT. SPACING THROUGH CURVE.

CLEAR BRUSH AS REQUIRED TO IMPROVE SIGHT DISTANCE.

IMPROVEMENT DIAGRAM
LOCATION 12
CURVE ON ROAD TO CITY DUMP
JUST WEST OF BLUE CREEK RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 35.

LOCATION NO. 13

This location is the intersection of Greenwood Avenue with Old Hardin Road.

Evaluation

This location is a "T" intersection with the Greenwood Avenue leg controlled by a stop sign. 1978 ADT at this location is as follows:

Old Hardin Road ADT = 5215 VPD
Greenwood Avenue ADT = 133 VPD

Four accidents were reported at this location during the study period. Three of these were caused by improper passing while one was attributed to icy road conditions.

Sight distance does not appear to be a problem at this location. Due to the nature of the accidents no action is recommended.

SITE NUMBER 13 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
2	-	2

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	2	1	-	-	-	-	1	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	1	-	1	-	2

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
2	2	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
2	1	-	1	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
3	-	-	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
2	1	1	-	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
2	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
4	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	-	1
No. fatal.	-	-	-
No. P.D.O.	1	-	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 13 Date April 18, 1979

Site Description Intersection of Greenwood Ave. and Old Hardin Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.283	=	9.06
Accident Rate	0.68 acc/MEV	12	x	0.388	=	4.66
Accident Severity	6,450 dollars	49	x	0.329	=	16.12
		Sums:		1.00 *		29.84

H.I. = Sum of Partial H.I.'s / Sum of Applicable Weights = -- = --

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/1000 vehicles

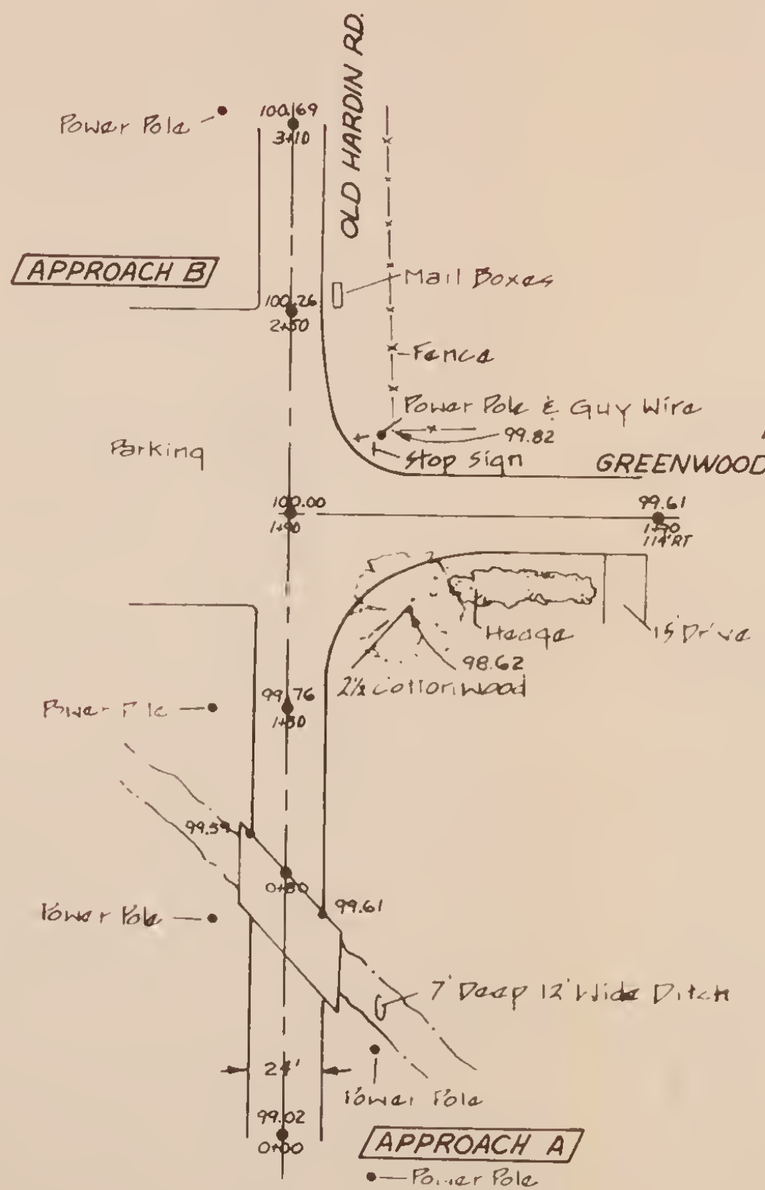
Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

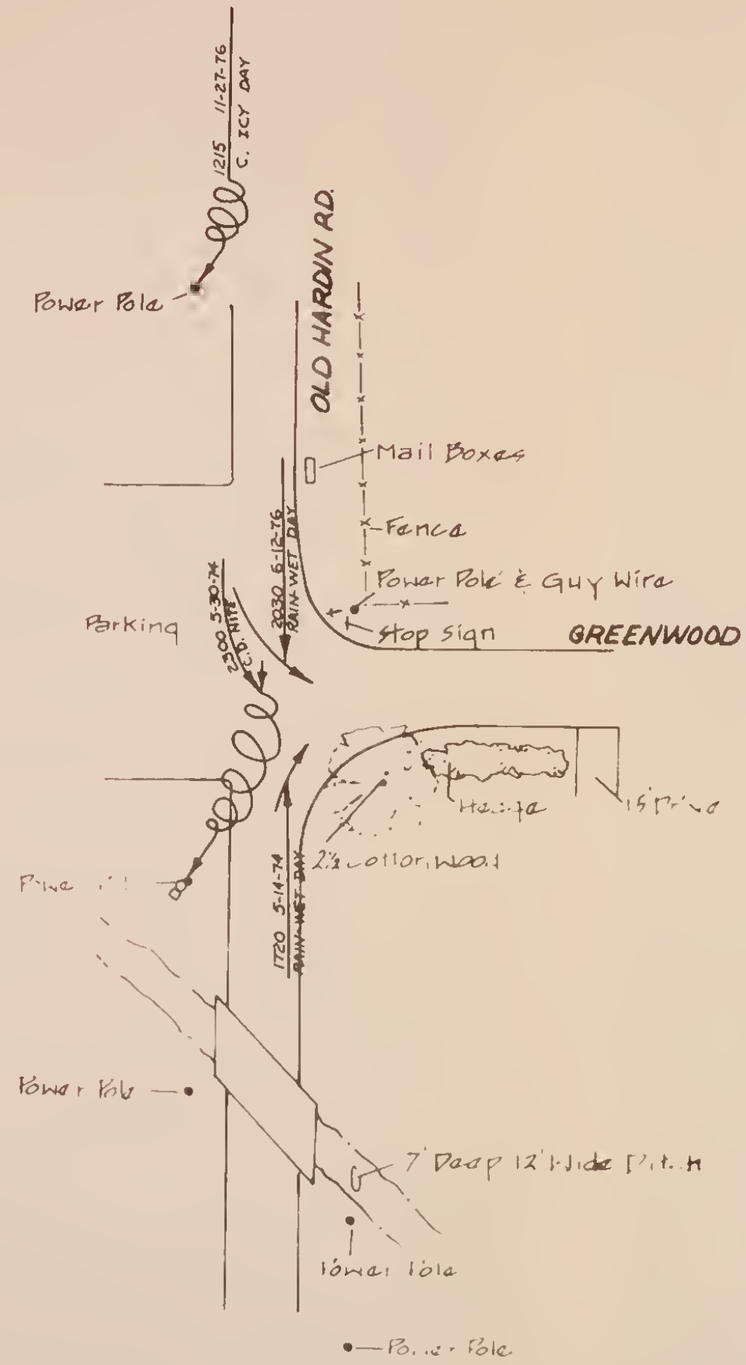


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CONDITION DIAGRAM
LOCATION 13
INTERSECTION OF
GREENWOOD AVE. AND OLD HARDIN RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 36



ACCIDENT DIAGRAM
LOCATION 13
INTERSECTION OF
GREENWOOD AVE. AND OLD HARDIN RD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 37.

LOCATION NO. 14

This location is the first sharp curve on Garden Avenue south of 27th Street.

Evaluation

This location consists of a single sharp curve on a local road. 1978 ADT in this area is 1078 vehicles per day.

Five accidents were reported at this location during the study period. Two of these accidents involved vehicles leaving the roadway at night. These occurred under dry road surface conditions. Two other accidents involved drunk driving and one was attributed to driver error.

Existing curve data are as follows:

Δ = 45° 48'
E = 15 ft. $\pm$
T = 75 ft.
R = 180 ft.
e = 0.147 ft./ft.

Safe driving speed on this curve is determined to be 23 mph.

The posted speed limit in this area is 25 mph. Sight distance is somewhat restricted by brush growing along a fence near the edge of the right-of-way.

Recommended Improvements

Our recommendation is to add 25 mph speed advisory plates (W13-1) to the existing curve warning signs. It is also recommended that delineators be added along the outside of the curve and that brush

be removed along the inside of the curve to improve sight distance.

Estimated cost for these improvements is $400.00.

SITE NUMBER 14 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
-	4	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	1	-	1	1	-	-	1	1	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	2	-	-	1	1	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
4	-	-	-	1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
5	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
1	-	-	4

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COI	HEAD-ON	LIVESTOCK
-	-	1	-	1	-	3	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
3	2	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
5	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	2	-
No. fatal.	-	-	-
No. P.D.O.	-	2	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 14 Date April 18, 1979

Site Description Garden Avenue south of 27th Street

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.67 acc/yr	34	x	0.283	=	9.62
Accident Rate	4.25 acc/MEV	60	x	0.388	=	23.28
Accident Severity	11,200 dollars	62	x	0.329	=	20.40
		Sums:		1.000*		53.30

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = -- %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.18 $/1000 vehicles

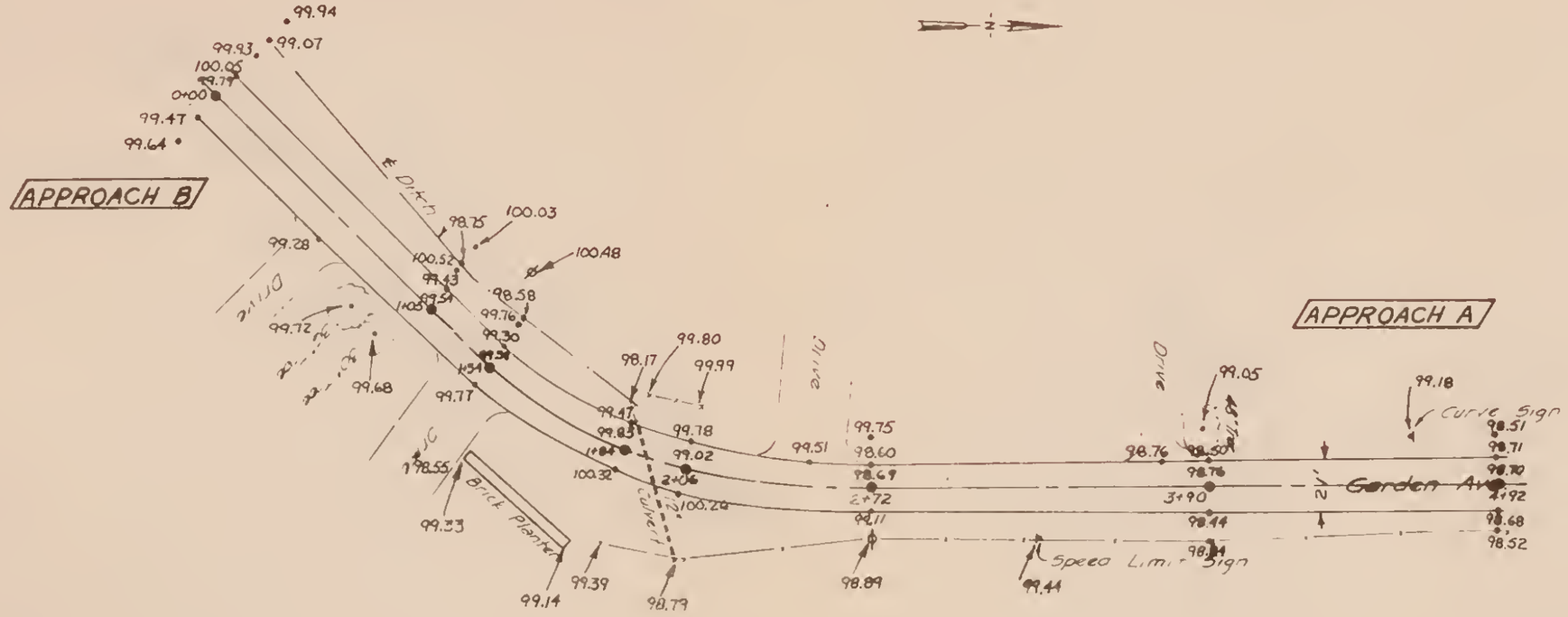
Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 53.30 + 0.25 x 100

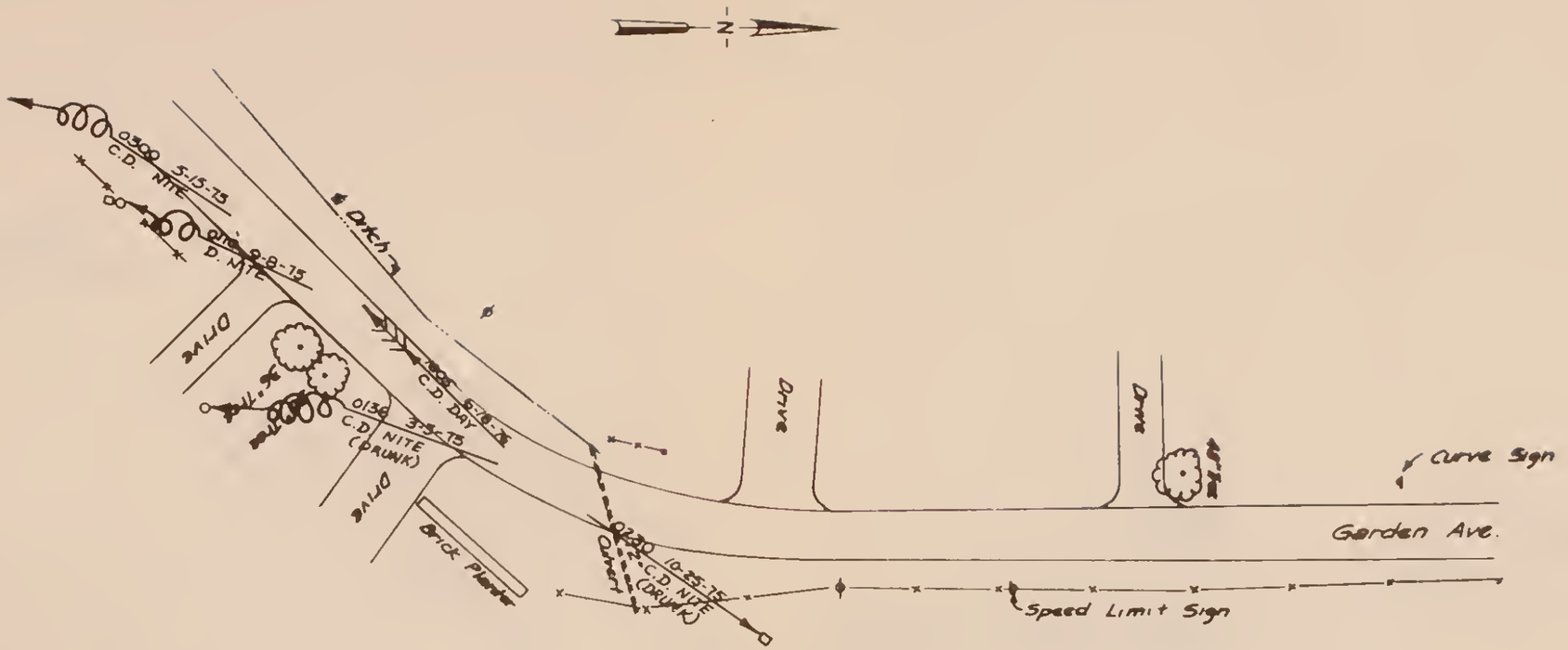
P.I. = 65.0



CONDITION DIAGRAM
LOCATION 14
GARDEN AVE.
SOUTH OF 27th. ST.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 38.

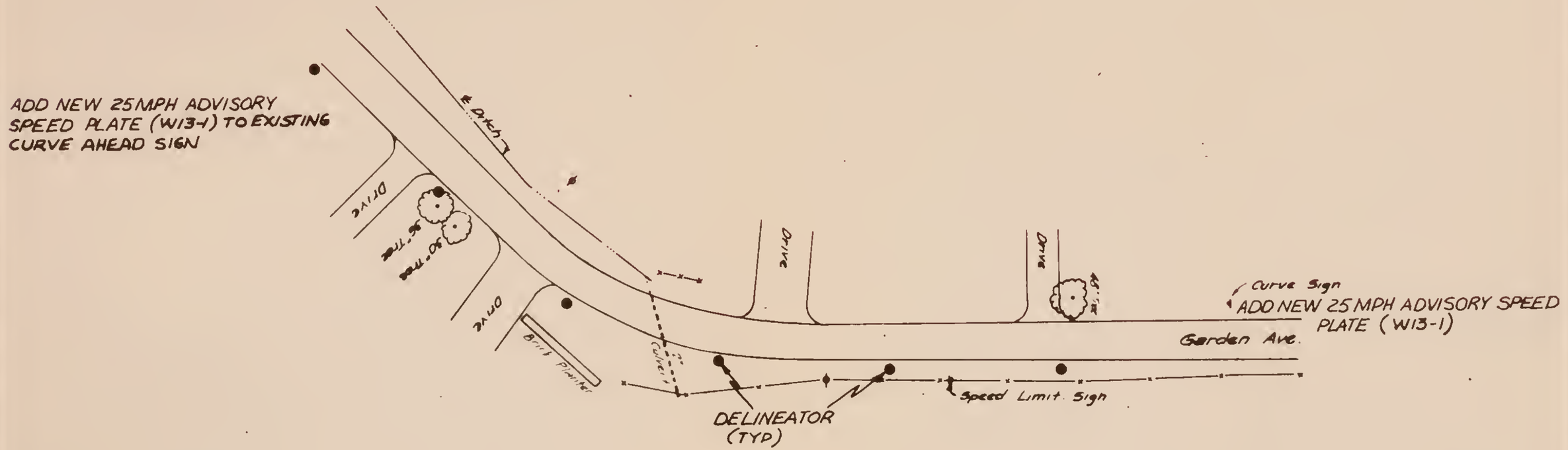


ACCIDENT DIAGRAM
LOCATION 14

GARDEN AVE.
SOUTH OF 27th. ST.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 39.



IMPROVEMENT DIAGRAM
LOCATION 14
GARDEN AVE.
SOUTH OF 27th ST.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 40.

LOCATION NO. 15

This location is on Yellowstone River Road and is the first curve east of Bench Blvd.

Evaluation

Yellowstone River Road serves as a collector route in this area. The location under consideration consists of a sharp curve located above Coulson Park. 1978 ADT is 1662 vehicles per day.

Two accidents were reported during the study period. Both occurred on dry pavement and involved vehicles which left the road in the curve.

Existing curve data are as follows:

$= 72° 30'$
$E = 44 \text{ ft.} \pm$
$T = 134 \text{ ft.}$
$R = 185 \text{ ft.}$
$e = 0.043 \text{ ft./ft.}$

Safe driving speed at this location is determined to be 23 mph.

The speed limit in this area is 35 mph. Sight distance at this location is adequate. Existing signing appears to be adequate.

Recommended Improvements

Based on the nature of this road and the traffic volume it serves, it is our recommendation that this curve be reconstructed to a 35 mph standard. The preliminary cost estimate for this reconstruction is $52,000.00 including right-of-way acquisition and engineering.

SITE NUMBER 15 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	-	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	-	-	2	-	-	-	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	1	-	-	1	-	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
2	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
2	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
1	-	-	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	-	1	-	-	-	1	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
1	1	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
2	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	1	-	-
No. fatal.	-	-	-
No. P.D.O.	-	-	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 15 Date April 18, 1979

Site Description Yellowstone River Rd. - first curve east of Bench Blvd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	0.67 acc/yr	21	x	0.283	=	5.95
Accident Rate	1.10 acc/MEV	20	x	0.388	=	7.76
Accident Severity	12,400 dollars	65	x	0.329	=	21.39
		Sums:		1.000*		35.10

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 15.04 $/1000 vehicles

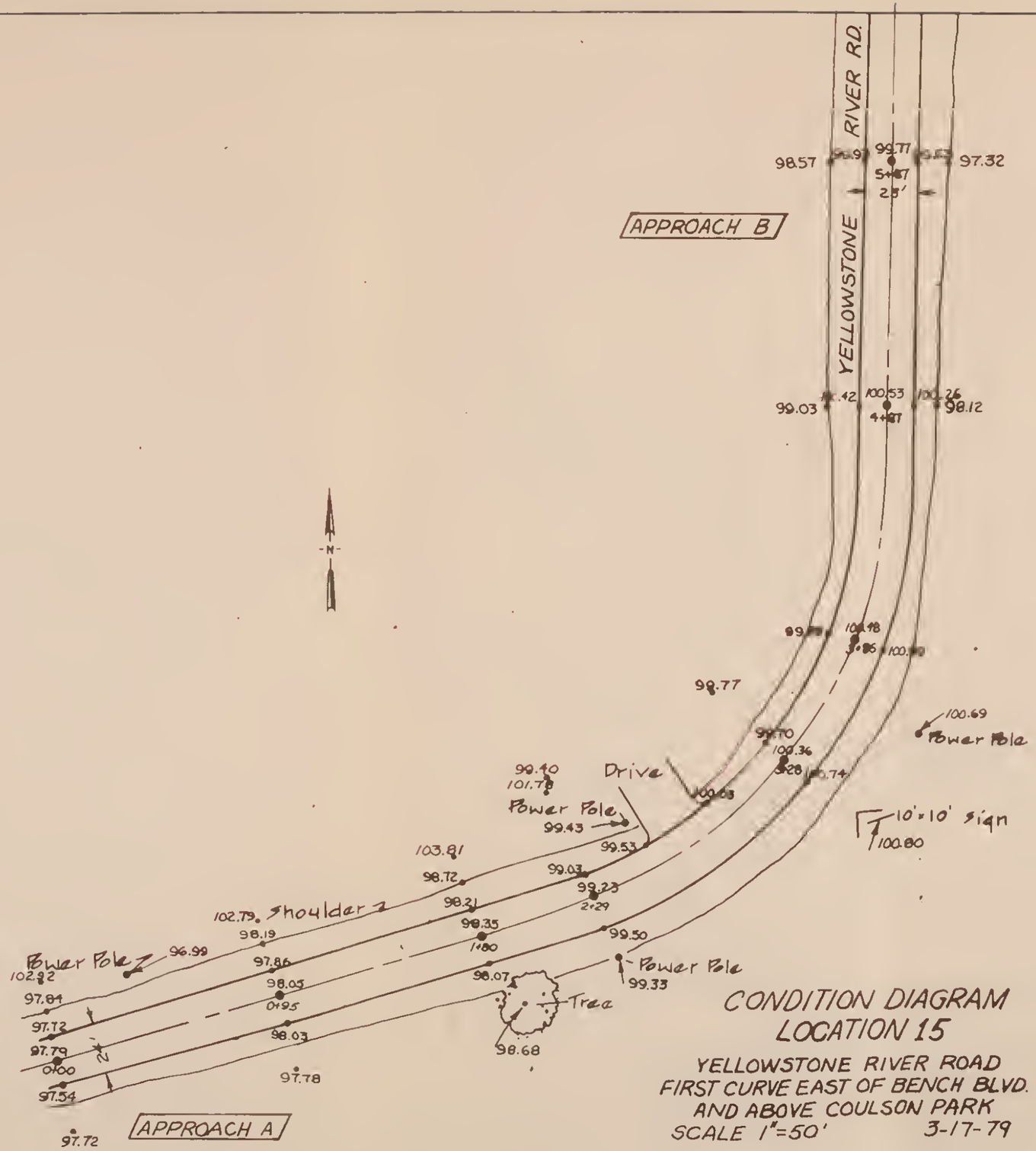
Cost Factor: 71

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 35.10 + 0.25 x 71

P.I. = 44.1

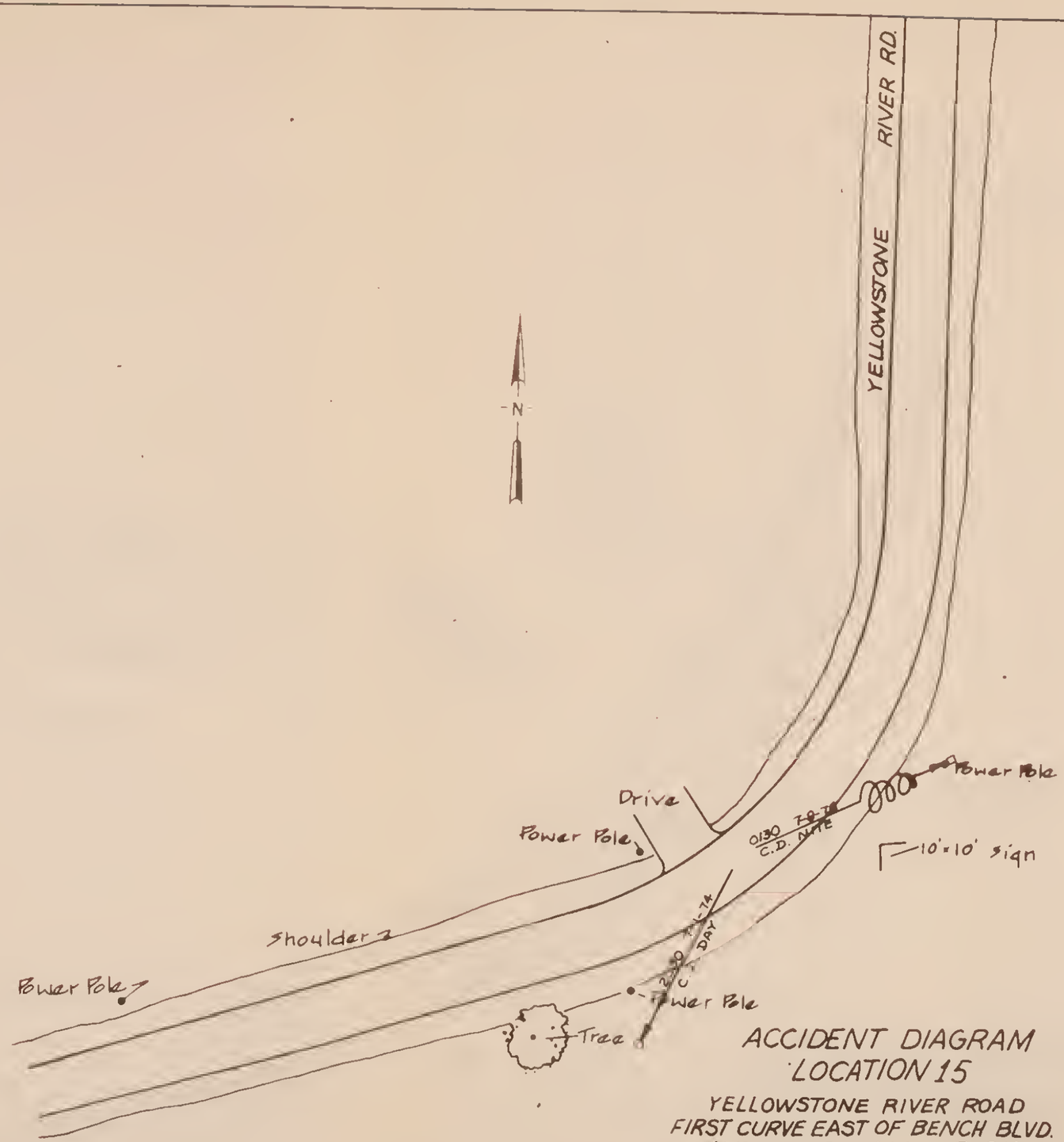


CONDITION DIAGRAM
LOCATION 15

YELLOWSTONE RIVER ROAD
FIRST CURVE EAST OF BENCH BLVD.
AND ABOVE COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 41.

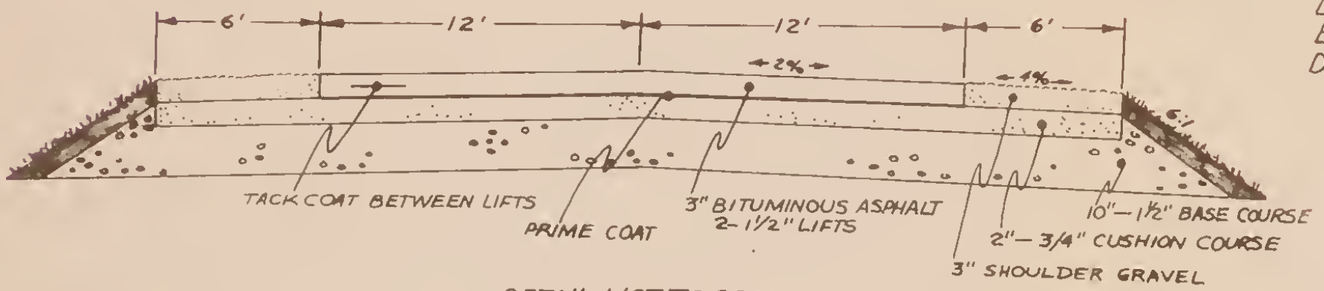


ACCIDENT DIAGRAM
LOCATION 15

YELLOWSTONE RIVER ROAD
FIRST CURVE EAST OF BENCH BLVD.
AND ABOVE COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 42.



DETAIL NOT TO SCALE



Δ= 72°30'
R= 390
T= 285.96'
D= 14°41'24"
L= 493.53'
E= 93.60'
DESIGN SPEED-35MPH

IMPROVEMENT DIAGRAM
LOCATION 15

YELLOWSTONE RIVER ROAD
FIRST CURVE EAST OF BENCH BLVD.
AND ABOVE COULSON PARK
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 43.

LOCATION NO. 16

This location is Third Street in Worden.

Evaluation

The section of Third Street under consideration extends from the railroad tracks south of U.S. Highway 10 to Lewis Avenue. Total length of this section is about 0.19 miles. 1978 ADT on this street is 1541 vehicles per day.

Twenty-six accidents were reported during the study period. Of these, two occurred at the railroad tracks and were attributed to mechanical problems with the vehicles. Two accidents occurred at the intersection of Third Street and the County road immediately north of U.S. Highway 10. One occurred at the intersection of Third Street and Lewis Avenue.

Sixteen of the accidents at this location involved vehicles backing out of a parking space into Third Street. The remaining five primarily involved driver error.

The pavement section on Third Street is typically 64 feet wide from back of curb to back of curb. Angle parking is prevelant from the County road north of U.S. 10 to Lewis Avenue.

The main problem at this location is the angle parking situation. Although sight distance for traffic on Third Street is adequate for a 25 mph traffic speed, drivers cannot always tell if a parked vehicle will back out of a parking stall. The vision of a driver in a parked vehicle may be impaired by another parked vehicle. These factors combined with the relatively high traffic volumes on Third street, result in a high number of vehicle conflicts and accidents.

Recommended Improvements

The only apparent solution to the problems at this location is to eliminate the angle parking. This will also improve the sight distance for vehicles attempting to enter or cross Third Street from side streets.

Our recommendation is therefore to eliminate the angle parking situation and to provide signing and striping for parallel parking at this location. Estimated cost of these improvements is $1000.00.

SITE NUMBER 16 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
10	8	8

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
3	2	2	1	1	-	4	-	3	3	2	5

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
4	2	3	3	1	5	8

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
23	-	3	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
19	2	-	5	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
16	1	8	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
6	1	1	-	17	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
26	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
26	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	-	-
No. fatal.	-	-	-
No. P.D.O.	10	8	8

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 16 Date April 18, 1979

Site Description 3rd Street in Worden

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	8.67 acc/yr	73	x	0.283	=	20.65
Accident Rate	15.43 acc/MEV	100	x	0.388	=	38.80
Accident Severity	3,212 dollars	38	x	0.329	=	12.50
		Sums:		1.000*		71.95

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.31 $/1000 vehicles

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 71.95 + 0.25 x 100

P.I. = 79.0

APPROACH D

Light Pole

Dia Tree

Bldg.

Light Pole

Bldg.

Light Pole

Fire Hydrant

Stop Sign

US HWY 10

Power Pole

3x10 Sign

1st

Stop Sign

RR Gate

Fire Hydrant

APPROACH A

RR Gate

Power Pole

Power Pole

Stop Signs

US HWY 10

3RD AVE.

BACK OF CURB 32' 32'

94.48 5+00

94.73 4+00

95.31 3+00

95.34 2+81

96.15 2+00

97.58 0+00

LEWIS AVE

APPROACH C

Bldg.

Alley

Fire Hydrant

APPROACH B

Bldg.

Bldg.

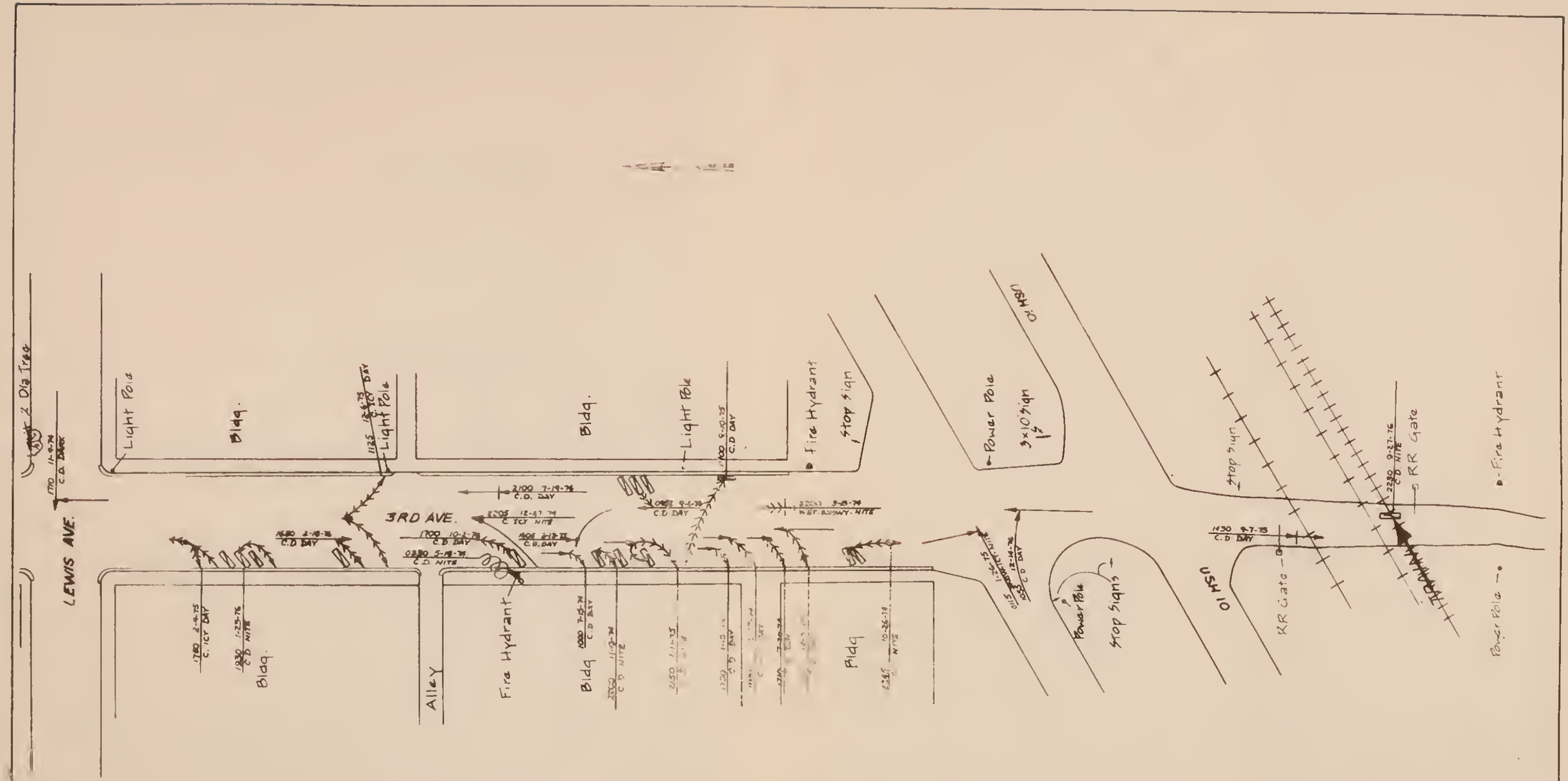
CONDITION DIAGRAM
LOCATION 16

3RD. ST. IN WORDEN
FROM 100' SOUTH OF RR TRACKS TO
100' NORTH OF LEWIS AVE.

0 50' 100' 5-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 44.



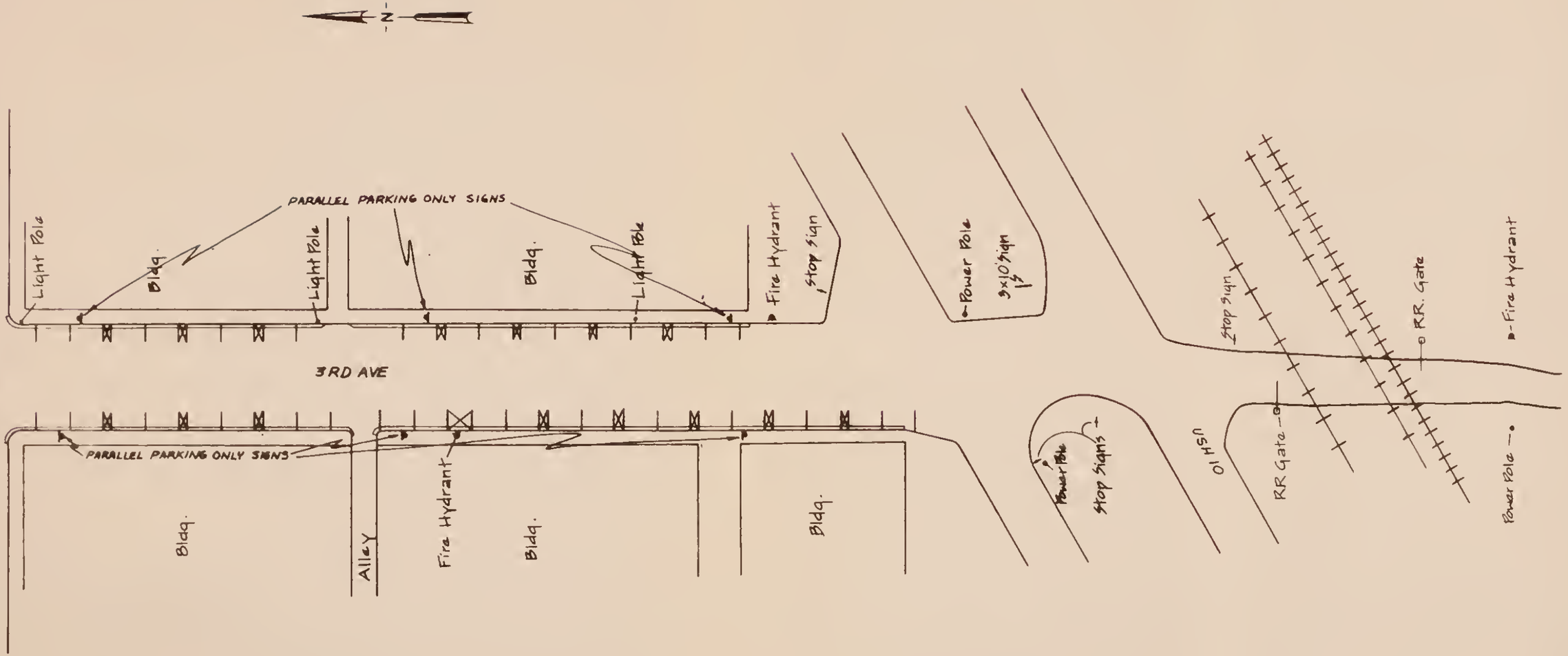
ACCIDENT DIAGRAM
LOCATION 16

3RD. ST. IN WORDEN
FROM 100' SOUTH OF RR TRACKS TO
100' NORTH OF LEWIS AVE.

0 50' 100' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 15



IMPROVEMENT DIAGRAM
LOCATION 16

3RD ST. IN WORDEN
FROM 100' SOUTH OF RR TRACKS TO
100' NORTH OF LEWIS AVE.

0 50' 100' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 46.

LOCATION NO. 17

This location is on 32nd Street West just north of King Avenue.

Evaluation

The section under study is a straight alignment approximately 0.11 miles in length. 1978 ADT at this location is 664 vehicles per day.

Three accidents were reported at this location during the study period. One accident involved a vehicle hitting a cow. The other two were caused by driver error although one of these involved a vehicle which hit a bridge.

The posted speed limit at this location is 35 mph. Sight distance is adequate.

Recommended Improvements

The accidents at this locations are not the result of any apparent engineering problem. However, it is recommended that Type III object markers be installed on both approach ends to the bridge. Estimated cost of the improvements is $60.00.

SITE NUMBER 17 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
1	1	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	1	-	-	-	-	2	-	-	-	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	1	1	-	1	-

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
1	-	-	2

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	-	1	-	-	-	1	-	1

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
2	1	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
3	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	1	-
No. fatal.	-	-	-
No. P.D.O.	1	-	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 17 Date April 18, 1979

Site Description 32nd Street West just north of King Avenue

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.283	=	7.36
Accident Rate	4.13 acc/MEV	59	x	0.388	=	22.89
Accident Severity	6,600 dollars	50	x	0.329	=	16.45
		Sums:		1.000*		46.70

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.04 $/1000 vehicles

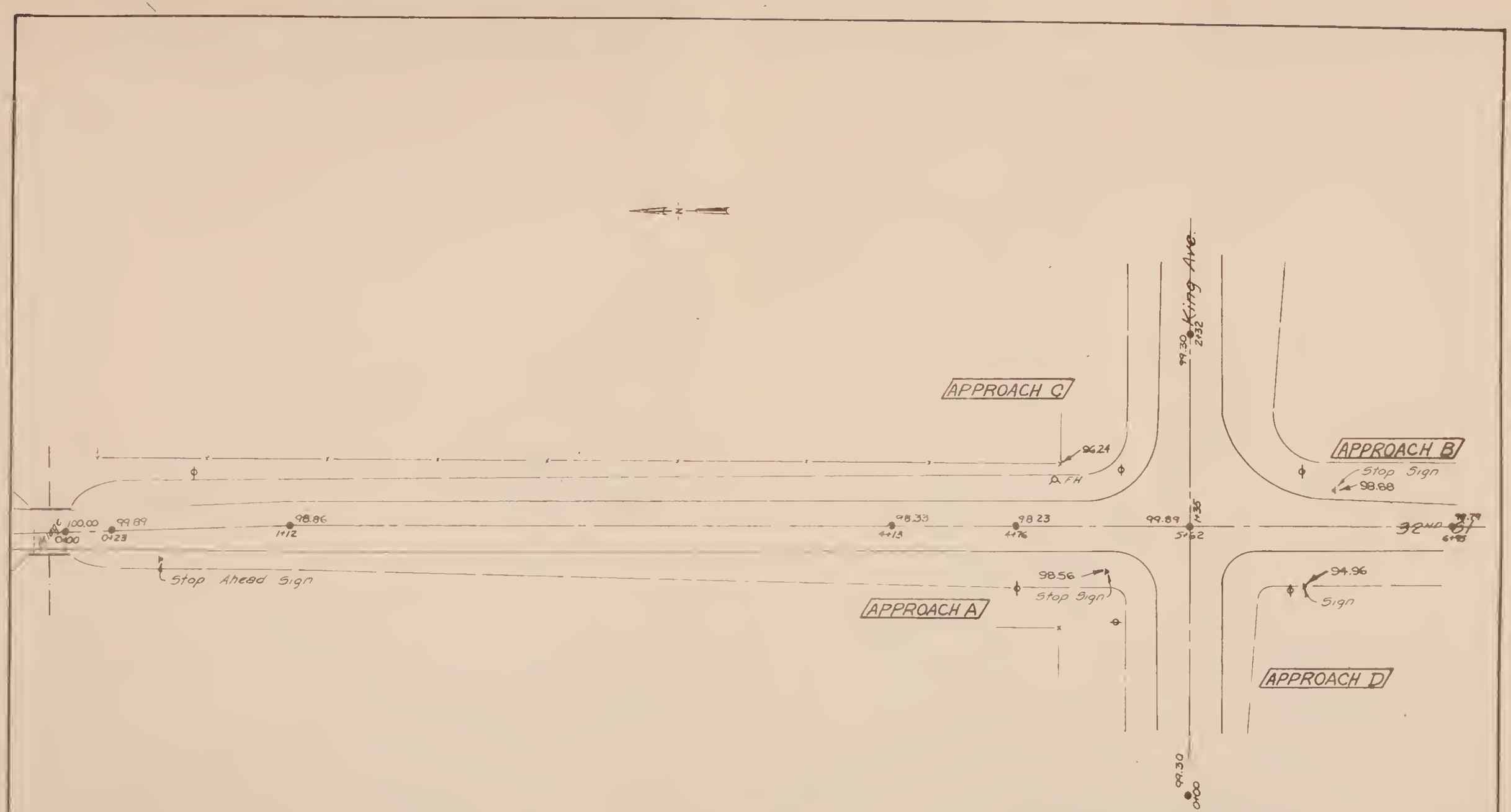
Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 46.70 + 0.25 x 100

P.I. = 60.0

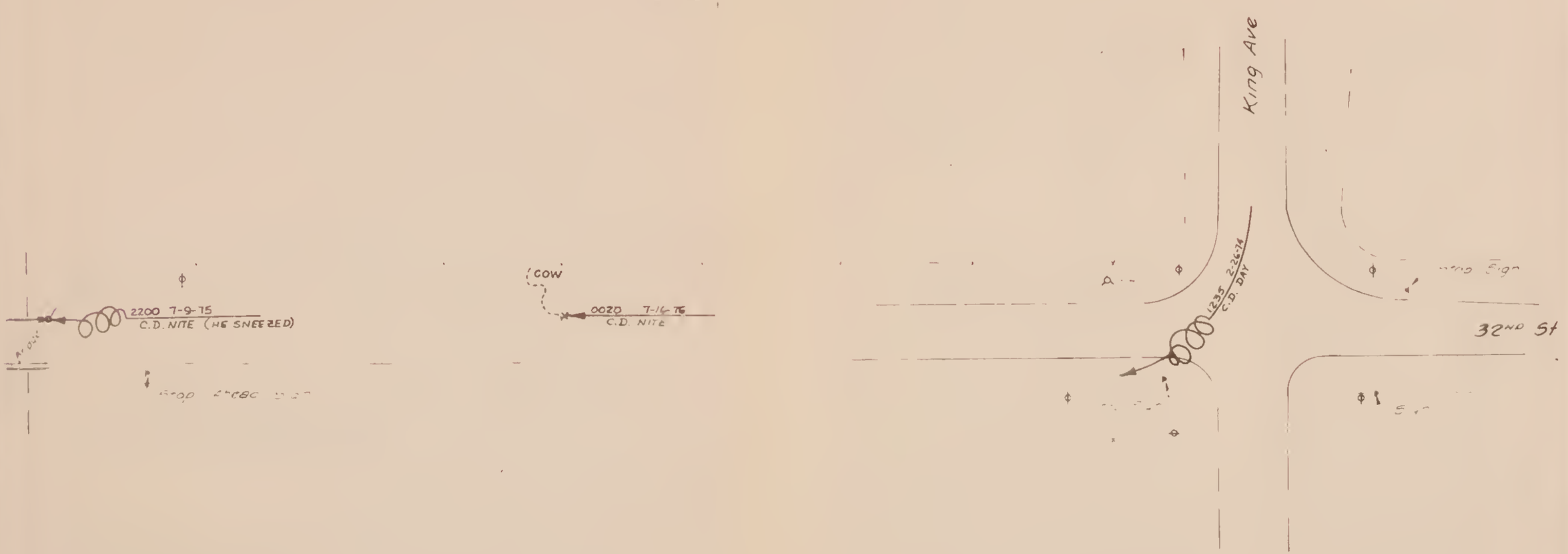


CONDITION DIAGRAM
LOCATION 17

32ND. ST. W.
JUST NORTH OF KING AVE.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 47.



ACCIDENT DIAGRAM
LOCATION 17

32ND. ST. W.
JUST NORTH OF KING AVE.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 18.



IMPROVEMENT DIAGRAM
LOCATION 17

32ND. ST. W.
JUST NORTH OF KING AVE.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 49.

LOCATION NO. 18

This location is the intersection of Pemberton Lane and Lake Elmo Drive. Also included are the curves immediately south of the intersection.

Evaluation

Initial accident data indicated the problem at this location was at the intersection. However, the curves south of the intersection also appear to contribute to the problem. The curves were therefore included in the evaluation. 1978 ADT entering this location is 309 vehicles per day.

Three accidents were reported at this location during the study period. All occurred on clear days with dry road surface conditions. One accident occurred at the intersection and was attributed to driver error. Two accidents involved vehicles leaving the roadway. One of these was attributed to the curves while the other was apparently caused by driver error.

Proceeding north toward the intersection the curves will be identified as curves 1 and 2.

Existing curve data are as follows:

Curve 1		Curve 2	
Δ	= 47°	Δ	= 32° 30'
E	= 13 ft. $\pm$	E	= 6 ft. $\pm$
T	= 63 ft.	T	= 42 ft.
R	= 144 ft.	R	= 144 ft.
e	= 0.05 ft./ft. (assumed)	e	= 0.05 ft/ft. (assumed)

The safe driving speed for both curves is determined to be 20 mph.

Sight distance and signing at the intersection appear adequate. However, sight distance in the curves is somewhat restricted by brush growing near the roadway. Also signing of the curves could be upgraded.

Recommended Improvements

Our recommendation is that curve warning signs (W1-4) with 20 mph advisory speed plates (W13-1) be installed on the approaches to the curves. It is also recommended that delineators be installed along the west side of the road through the curves and that brush be removed as required to improve sight distance. Estimated cost of these improvements is $610.00.

SITE NUMBER 18 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
-	2	1

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	-	-	-	-	1	-	1	1	-	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
1	-	-	1	-	-	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	-	-	-	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
1	-	-	2

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
-	1	1	-	-	-	1	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
2	1	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
3	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	1	-
No. fatal.	-	-	-
No. P.D.O.	-	1	1

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 18 Date April 18, 1979

Site Description Intersection of Lake Elmo Rd. with Pemberton Ln.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.283	=	7.36
Accident Rate	8.85 acc/MEV	95	x	0.388	=	36.86
Accident Severity	9,367 dollars	57	x	0.329	=	18.76
		Sums:		1.000*		62.98

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.95 $/1000 vehicles

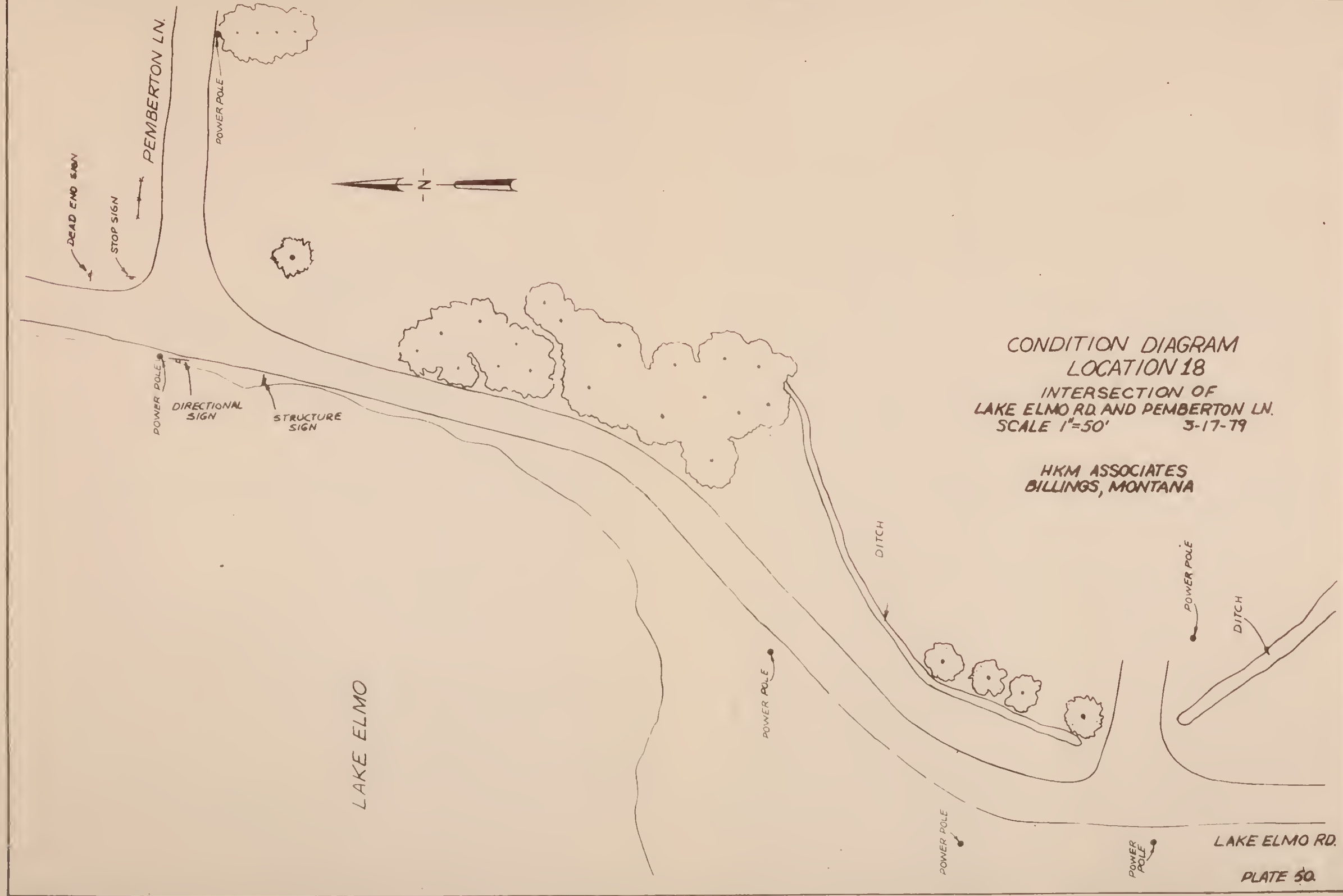
Cost Factor: 97

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 62.98 + 0.25 x 97

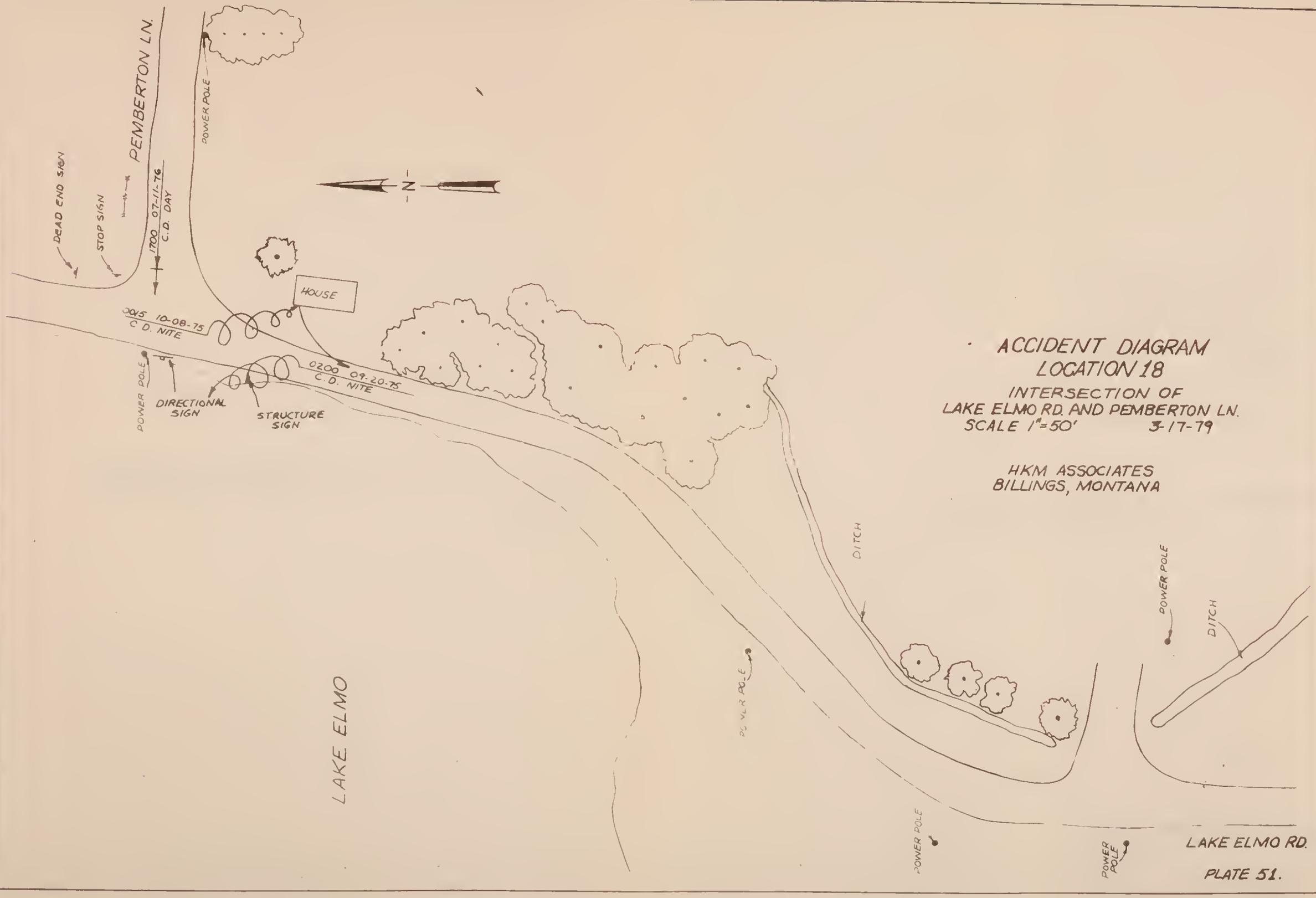
P.I. = 71.5



CONDITION DIAGRAM
LOCATION 18
INTERSECTION OF
LAKE ELMO RD. AND PEMBERTON LN.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 50.

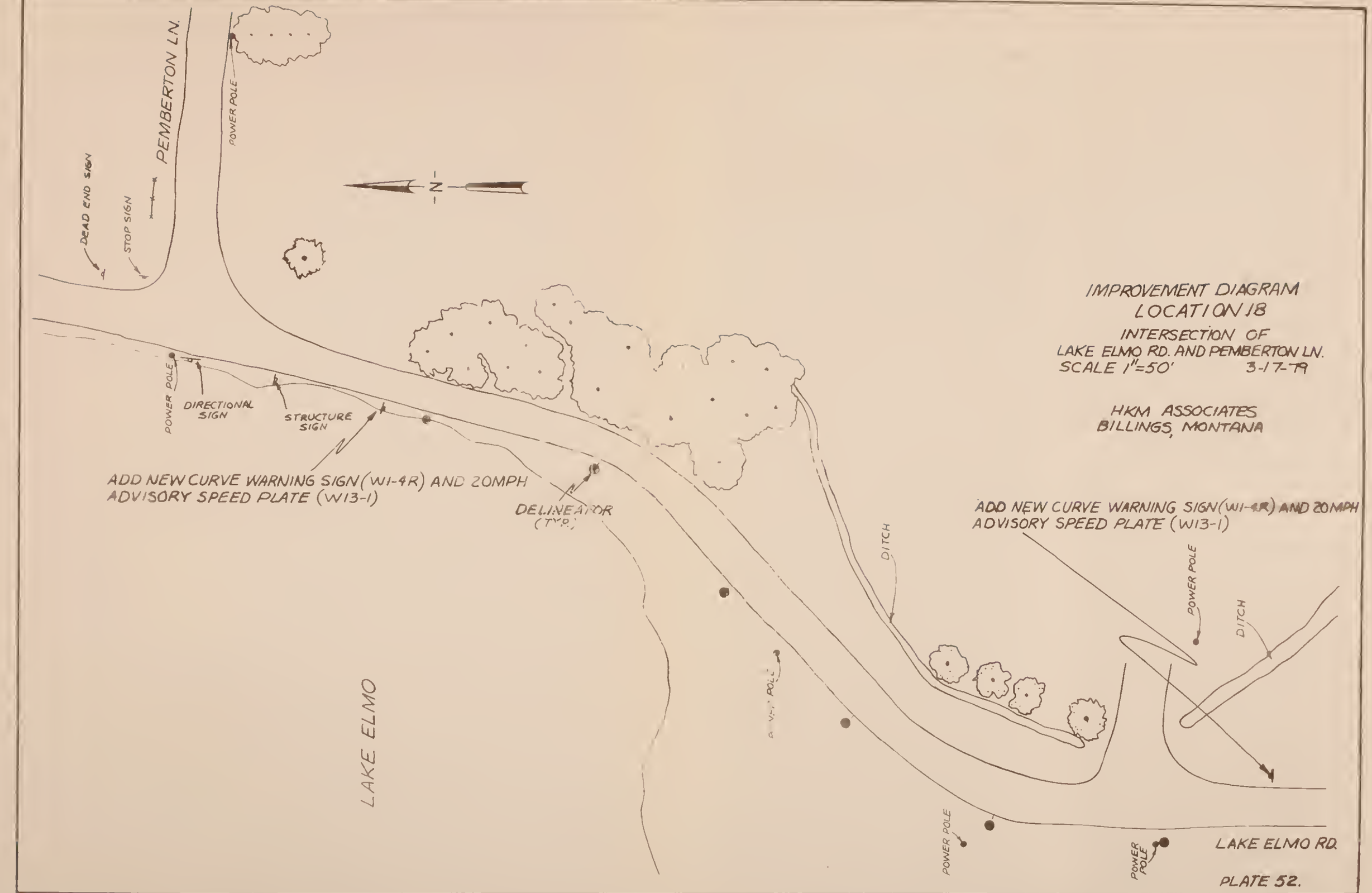


ACCIDENT DIAGRAM
LOCATION 18

INTERSECTION OF
LAKE ELMO RD. AND PEMBERTON LN.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 51.



IMPROVEMENT DIAGRAM
LOCATION 18
INTERSECTION OF
LAKE ELMO RD. AND PEMBERTON LN.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 52.

LOCATION NO. 19

This location is the intersection of Bench Blvd. with Yellowstone River Road and Conway Street.

Evaluation

This location consists of an offset cross intersection of three collector routes. Bench Blvd. serves as the through route with the approaches from Conway Street and Yellowstone River Road offset approximately 110 feet from each other. 1978 ADT at this location is as follows:

Bench Blvd. ADT = 1363 VPD
Yellowstone River Road ADT = 2110 VPD
Conway Street ADT = 2687 VPD

Seven accidents were reported at this location during the study period. Three of these were attributed to icy road conditions. Two involved failure to negotiate a turn. One accident involved a vehicle backing from a driveway and one vehicle lost control.

Based on traffic volumes, Conway Street is the major leg of this intersection followed by Yellowstone River Road. However, vehicles approaching the intersection on these legs must stop before crossing or entering Bench Blvd. This situation, as well as the offset in the approaches, contribute to the hazardous conditions at this intersection.

If signals are installed as planned at the intersection of Conway Street and Main Street, traffic on Conway may increase substantially. Conway Street and Yellowstone River Road should be the through traffic legs of this intersection. This will require reconstruction of the intersection.

Recommended Improvement

Our recommendation is that this intersection be reconstructed to eliminate the offset and to provide the through traffic movement on Conway Street and Yellowstone River Road. This could be done presently without acquiring any residences as there is still some vacant property in this area. Reconstruction will be more difficult and expensive when this area develops.

The preliminary cost estimate for this reconstruction is $48,100.00 including right-of-way acquisition and engineering.

SITE NUMBER 19 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
5	-	2

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
3	-	-	1	-	1	-	-	-	1	-	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
2	1	2	-	-	1	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
5	1	-	-	1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
3	1	-	3	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
2	-	1	4

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	1	2	-	2	-	1	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
7	-	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
7	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	-	-
No. fatal.	-	-	-
No. P.D.O.	5	-	2

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 19 Date April 18, 1979

Site Description Intersection of Conway and Yellowstone River Rd. with Bench Blvd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33 acc/yr	40	x	0.283	=	11.32
Accident Rate	1.70 acc/MEV	28	x	0.388	=	10.86
Accident Severity	3,643 dollars	40	x	0.329	=	13.16
		Sums:		1.000*		35.34

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--} =$$

Relative Strength of Evaluation:

$$\text{Sum of Applicable Weights} \times 100 = 100\ \%$$

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 6.15 $/1000 vehicles

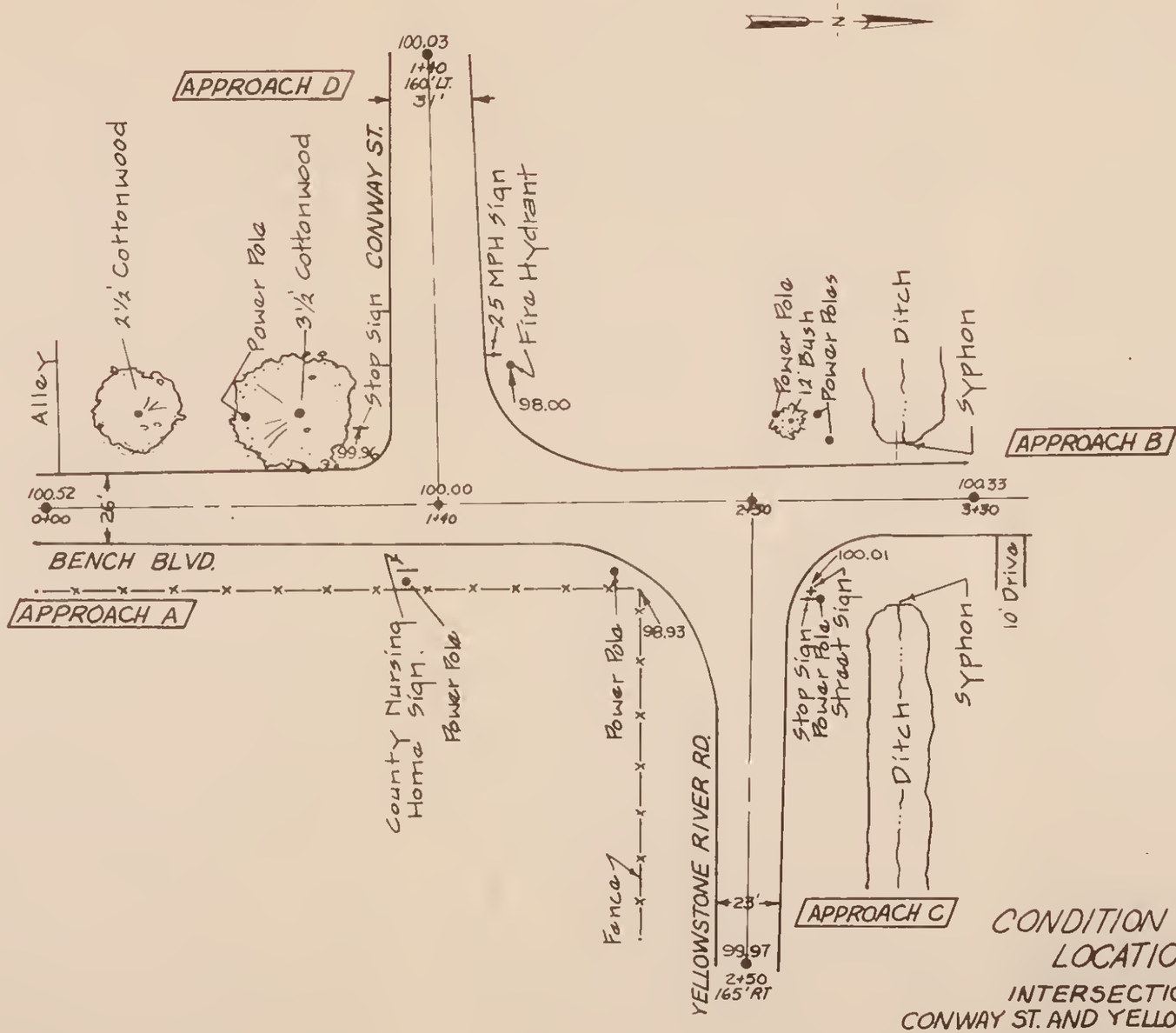
Cost Factor: 88

PRIORITY INDEX (P.I.)

$$P.I. = 0.75 \times (H.I.) + 0.25 \times (C.F.)$$

$$= 0.75 \times 35.34 + 0.25 \times 88$$

$$P.I. = 48.5$$



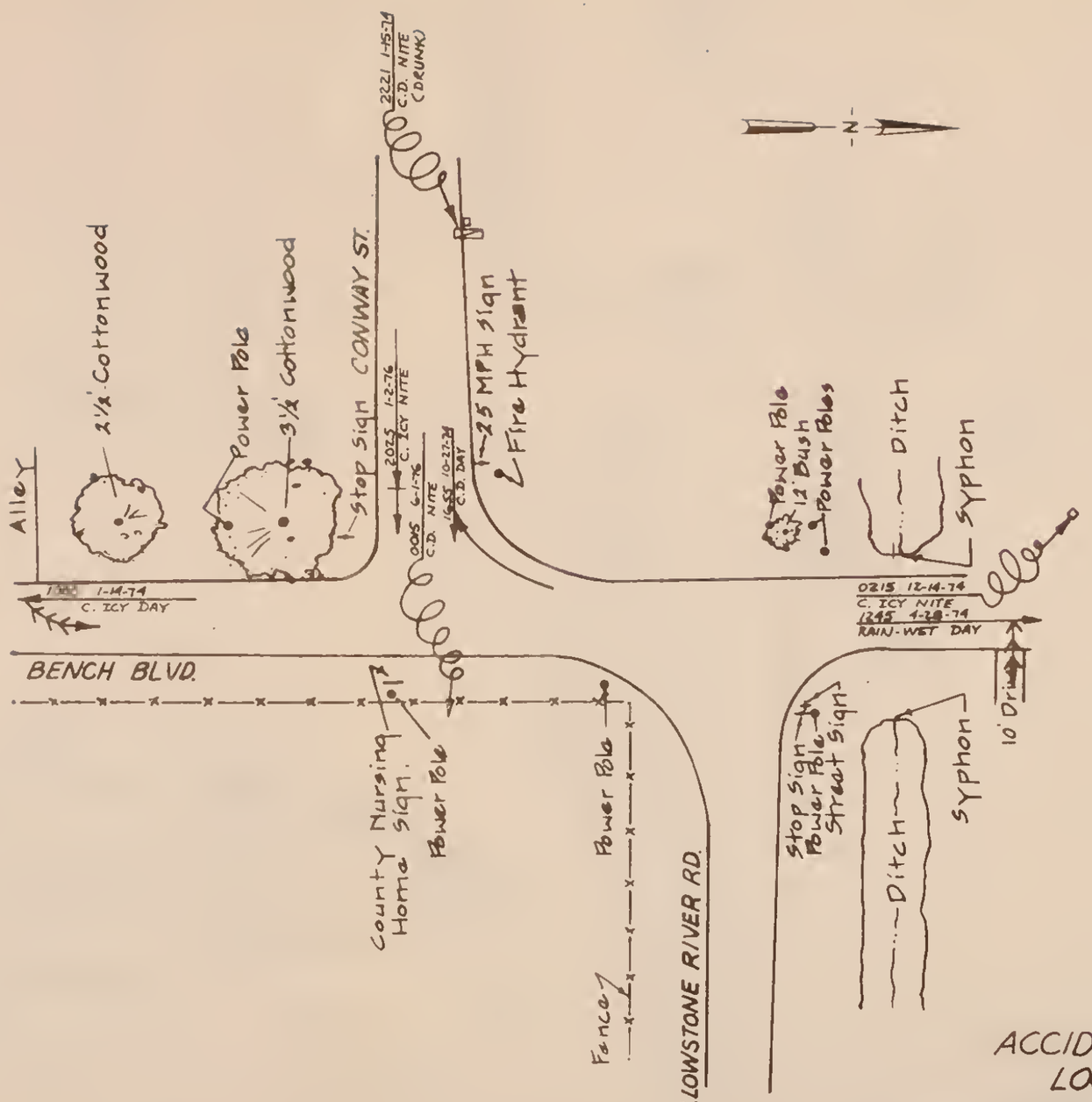
CONDITION DIAGRAM
LOCATION 19

INTERSECTION OF
CONWAY ST. AND YELLOWSTONE RIVER RD.
WITH BENCH BLVD.

SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

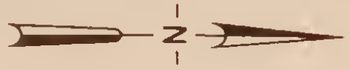
PLATE 53

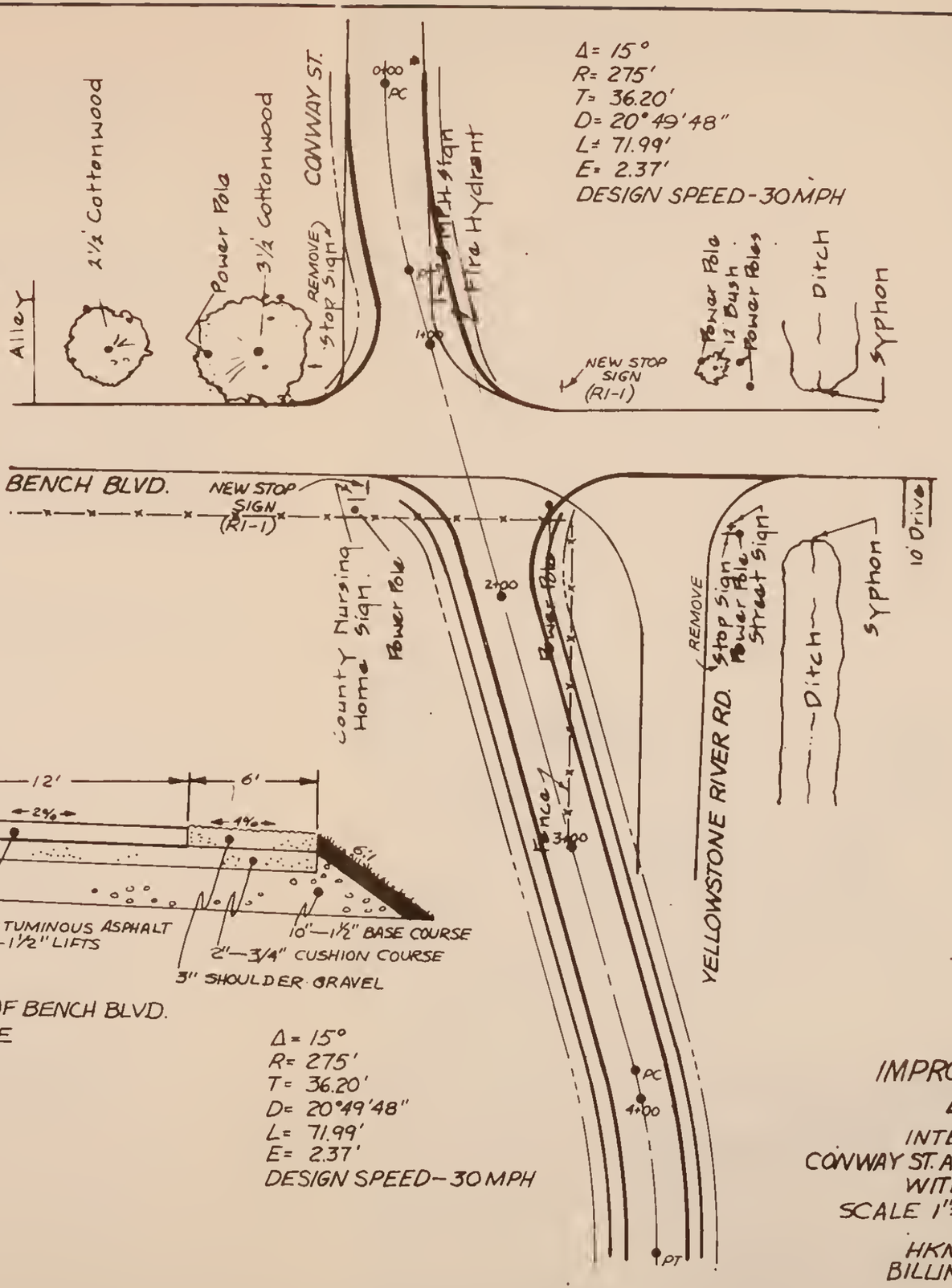


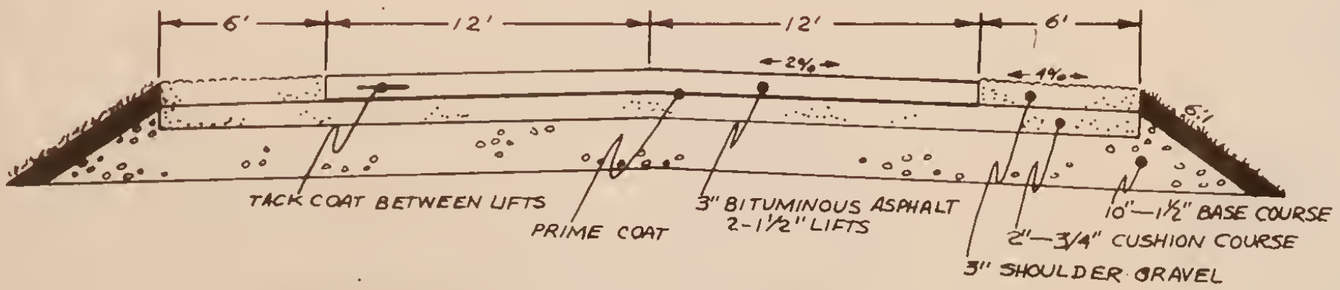
ACCIDENT DIAGRAM
LOCATION 19

INTERSECTION OF
CONWAY ST. AND YELLOWSTONE RIVER RD.
WITH BENCH BLVD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA PLATE 54.







YELLOWSTONE RIVER ROAD EAST OF BENCH BLVD.
DETAIL NOT TO SCALE

Δ= 15°
R= 275'
T= 36.20'
D= 20°49'48"
L= 71.99'
E= 2.37'
DESIGN SPEED–30 MPH

IMPROVEMENT DIAGRAM
LOCATION 19

INTERSECTION OF
CONWAY ST. AND YELLOWSTONE RIVER RD.
WITH BENCH BLVD.
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA PLATE 55.

LOCATION NO. 20

This location is the "S" curve on Yellowstone River Road by the County Nursing Home.

Evaluation

This location consists of a sharp reverse curve between Reece Drive and the entrance to the County Nursing Home. 1978 ADT on this section is 1215 vehicles per day.

Five accidents were reported at this location during the study period. Two of these were attributed to the degree of curvature or to sight distance restrictions. One involved striking a parked vehicle, one resulted from icy road conditions, and one can only be attributed to driver error.

The first curve east of Reece Drive is identified as curve 1 and the easterly curve as curve 2. Existing curve data are as follows:

Curve 1		Curve 2	
Δ	= 63°	Δ	= 71°
E	= 19 ft. $\pm$	E	= 42 ft. $\pm$
T	= 67 ft.	T	= 131 ft.
R	= 110 ft.	R	= 184 ft.
e	= 0.029 ft./ft.	e	= 0.037 ft./ft.

Safe driving speed for curves 1 and 2 are 17 mph and 23 mph respectively.

The speed limit in this area is 35 mph. Sight distance is restricted by fences near the roadway.

Recommended Improvement

Our recommendation for this location is to reconstruct the curves to a 35 mph design speed. The preliminary cost estimate for this reconstruction is $60,840.00 including right-of-way acquisition and engineering.

SITE NUMBER 20 ACCIDENT PERIOD 1974 thru 1976

1974	1975	1976
-	2	3

NUMBER OF ACCIDENTS BY MONTH

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
-	-	1	-	-	-	1	-	1	-	2	-

NUMBER OF ACCIDENTS BY DAY OF WEEK

SUN	MON	TUES	WED	THURS	FRI	SAT
-	-	-	1	1	1	2

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

CLEAR	RAINING	SNOWING	FOG	OTHER
3	-	2	-	-

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

DRY	WET	SNOWY	ICY	OTHER
2	-	1	2	-

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

DAYLIGHT	DAWN OR DUSK	DARK, LIGHTED	DARK,UNLIGHTED
3	-	1	1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

ANGLE	R-END	FX-OBJ	PED	BACKING	SIDWYP	NON-COL	HEAD-ON	LIVESTOCK
1	-	1	-	-	1	2	-	-

NUMBER OF ACCIDENTS BY NUMBER OF INJURIES

0	1	2	3	4	5
4	1	-	-	-	-

NUMBER OF ACCIDENTS BY NUMBER OF FATILITIES

0	1	2	3	4	5
5	-	-	-	-	-

YEARLY SUMMARY OF NUMBER OF INJURIES, NUMBER OF FATAILITIES, AND NUMBER OF PROPERTY DAMAGE ONLY

	1974	1975	1976
No. inj.	-	-	1
No. fatal.	-	-	-
No. P.D.O.	-	2	2

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 20 Date April 18, 1979

Site Description Yellowstone River Rd. "S" curve by County Nursing Home

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.67 acc/yr	34	x	0.283	=	9.62
Accident Rate	3.76 acc/MEV	57	x	0.388	=	22.12
Accident Severity	8,160 dollars	54	x	0.329	=	17.78
		Sums:		1.000*		49.52

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 24.06 $/1000 vehicles

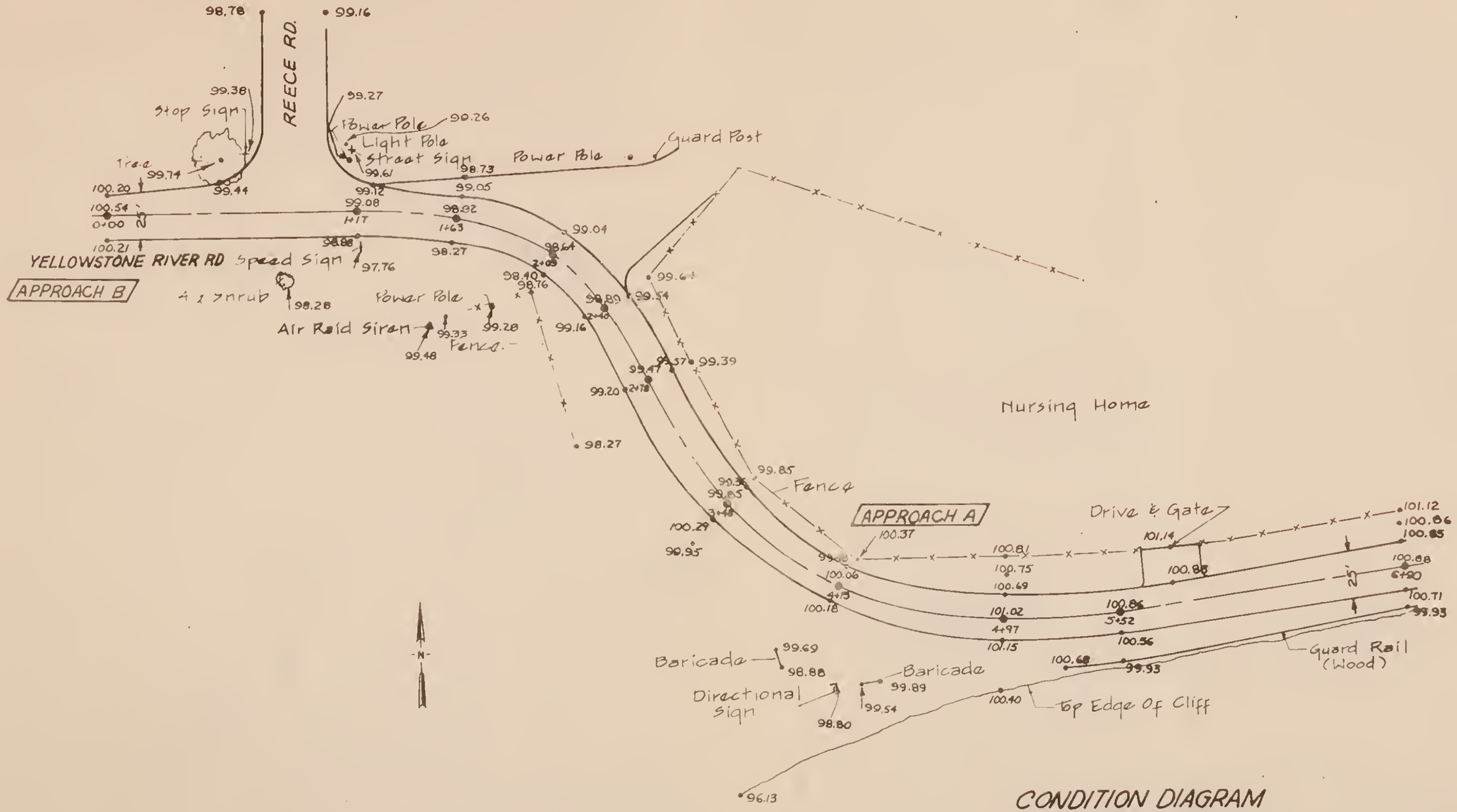
Cost Factor: 54

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 49.52 + 0.25 x 54

P.I. = 50.6

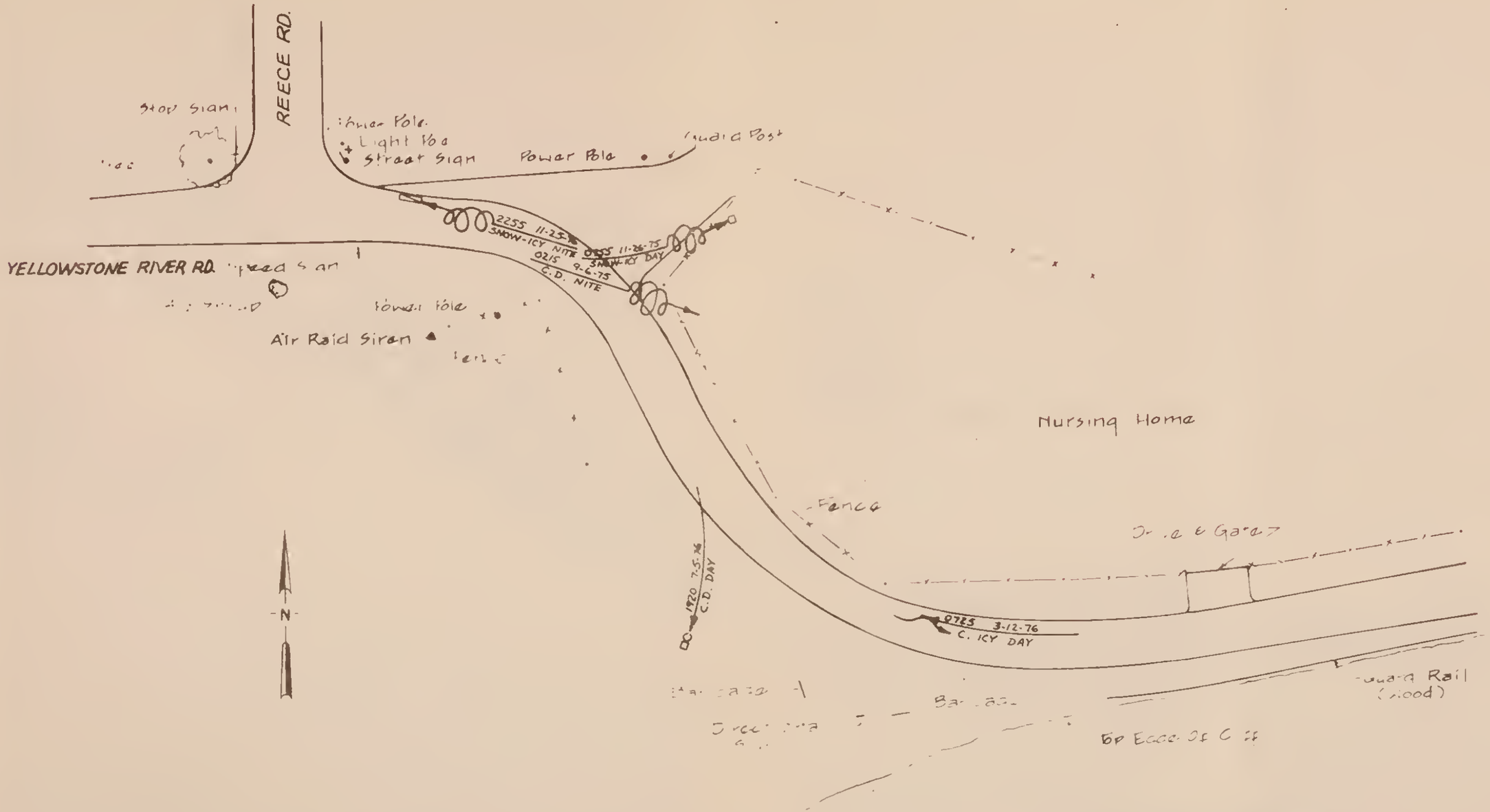


CONDITION DIAGRAM
LOCATION 20

YELLOWSTONE RIVER ROAD "S" CURVE
BY COUNTY NURSING HOME
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 56.



ACCIDENT DIAGRAM
LOCATION 20

YELLOWSTONE RIVER ROAD "S" CURVE
BY COUNTY NURSING HOME
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 57.

REECE DR.

24'ASPHALT PAV'T

6'GRAVEL SHOULDER

Power Pole

Light Pole

Street Sign

Power Pole

Guard Post

4.0°

1+00

PC

2+00

Road

Power Pole

Air Raid Siren

Fence

2+72

DT

PC

3+00

Fence

4+00

Drive & Gate

5+00

6+00

PT

YELLOWSTONE RIVER RD.

Guard Rail (Wood)

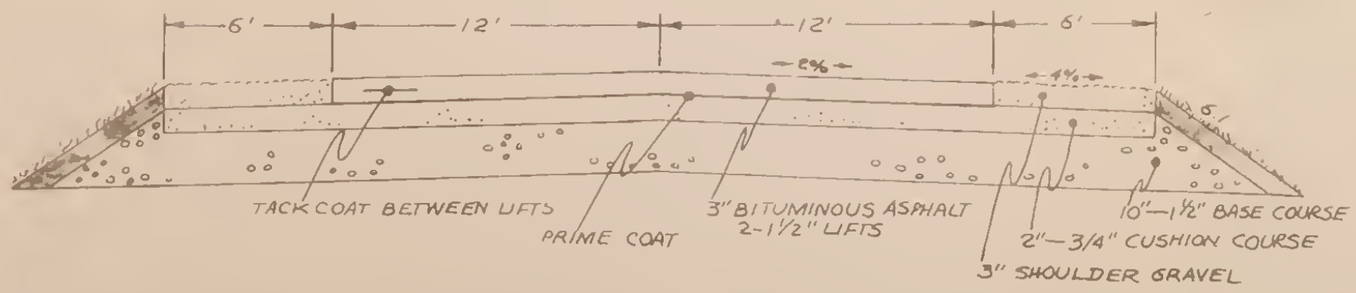
50° Barbed Wire

Top Edge Of Cliff

$\Delta = 40°$
$R = 390'$
$T = 141.95'$
$D = 14°41'24"$
$L = 272.29'$
$E = 25.03'$
DESIGN SPEED- 35 MPH

$\Delta = 50°$
$R = 390'$
$T = 181.86'$
$D = 14°41'24"$
$L = 340.37'$
$E = 40.32'$
DESIGN SPEED-35MPH Nursing Home

-N-



DETAIL NOT TO SCALE

IMPROVEMENT DIAGRAM
LOCATION 20

YELLOWSTONE RIVER ROAD "S" CURVE
BY COUNTY NURSING HOME
SCALE 1"=50' 3-17-79

HKM ASSOCIATES
BILLINGS, MONTANA

PLATE 58.

APPENDIX

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 1 Date April 16, 1979

Site Description County Road west of north end of Shiloh Rd. Overpass

HAZARD INDEX (H.I.)

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.33	acc/yr	47	x	0.164	=	7.71
Accident Rate	4.3	acc/MEV	60	x	0.225	=	13.50
Accident Severity	12,400	dollars	65	x	0.191	=	12.42
Volume/Capacity Ratio	0.0848		24	x	0.082	=	1.97
Sight Distance Ratio	Z2	(wt.avg)	0	x	0.074	=	0
Driver Expectancy	1.66	(wt.avg)	29	x	0.149	=	4.32
Info. System Deficiencies	2.0	(wt.avg)	41	x	0.115	=	4.72
			Sums:		1.000	=	44.64

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.01098 $/vehicle

Cost Factor: 79

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 44.64 + 0.25 x 79

P.I. = 53.2

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 2 Date April 16, 1979

Site Description Connection of Old Hardin Rd. with Dickie Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.33 acc/yr	47	x	0.164	=	7.71
Accident Rate	26.22 acc/MEV	100	x	0.225	=	22.50
Accident Severity	12,400 dollars	65	x	0.191	=	12.42
Volume/Capacity Ratio	0.019	10	x	0.082	=	0.82
Sight Distance Ratio	0 (wt.avg)	100	x	0.074	=	7.40
Driver Expectancy	3.33 (wt.avg)	53	x	0.149	=	7.90
Info. System Deficiencies	1.66 (wt.avg)	31	x	0.115	=	3.57
		Sums:		1.000	=	62.32

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.166 $/vehicle

Cost Factor: 10

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 62.32 + 0.25 x 10

P.I. = 49.2

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 3 Date April 16, 1979

Site Description Intersection of Bench Blvd. and Anchor St.

HAZARD INDEX (H.I.)

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.67	acc/yr	42	x	0.164	=	6.89
Accident Rate	2.7	acc/MEV	43	x	0.225	=	9.68
Accident Severity	4,412	dollars	43	x	0.191	=	8.21
Volume/Capacity Ratio	0.12		29	x	0.082	=	2.38
Sight Distance Ratio	0.7	(wt.avg)	70.33	x	0.074	=	5.20
Driver Expectancy	2.33	(wt.avg)	42	x	0.149	=	6.26
Info. System Deficiencies	1.66	(wt.avg)	31	x	0.115	=	3.57
			Sums:		1.000	=	42.19

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.0013 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 42.19 + 0.25 x 100

P.I. = 56.6

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 4 Date April 16, 1979

Site Description Bench Blvd. on curve south of entrance to Coulsen Park

HAZARD INDEX (H.I.)

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33	acc/yr	40	x	0.164	=	6.56
Accident Rate	3.94	acc/MEV	56	x	0.225	=	12.60
Accident Severity	6,014	dollars	48	x	0.191	=	9.17
Volume/Capacity Ratio	.0836		24	x	0.082	=	1.97
Sight Distance Ratio	1.5	(wt.avg)	10	x	0.074	=	0.74
Driver Expectancy	3.0	(wt.avg)	48	x	0.149	=	7.15
Info. System Deficiencies	2.5	(wt.avg)	46	x	0.115	=	5.29
			Sums:		1.000	=	43.48

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00006 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 43.48 + 0.25 x 100

P.I. = 57.6

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 5 Date April 16, 1979

Site Description Intersection of Grand Ave. with 54th St. West

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.164	=	5.25
Accident Rate	4.78 acc/MEV	65	x	0.225	=	14.63
Accident Severity	11,850 dollars	64	x	0.191	=	12.22
Volume/Capacity Ratio	0.0319	14	x	0.082	=	1.15
Sight Distance Ratio	0.75 (wt.avg)	67	x	0.074	=	4.96
Driver Expectancy	3.0 (wt.avg)	52	x	0.149	=	7.75
Info. System Deficiencies	2.0 (wt.avg)	42	x	0.115	=	4.83
		Sums:		1.000	=	50.79

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00841 $/vehicle

Cost Factor: 84

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 50.79 + 0.25 x 84

P.I. = 59.1

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 6 Date April 16, 1979

Site Description Bench Blvd. between Steffanich and Birch

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0 acc/yr	51	x	0.164	=	8.36
Accident Rate	8.29 acc/MEV	91	x	0.225	=	20.48
Accident Severity	3,342 dollars	38	x	0.191	=	7.26
Volume/Capacity Ratio	0.05	18	x	0.082	=	1.48
Sight Distance Ratio	Z 2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	3.0 (wt.avg)	49	x	0.149	=	7.30
Info. System Deficiencies	0.66 (wt.avg)	17	x	0.115	=	1.96
		Sums:		1.000	=	46.84

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 7 Date April 16, 1979

Site Description Curve on Old Chicago Rd just North of U.S. 312

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.164	=	4.26
Accident Rate	12.5 acc/MEV	100	x	0.225	=	22.50
Accident Severity	12,400 dollars	65	x	0.191	=	12.42
Volume/Capacity Ratio	0.0113	8	x	0.082	=	0.66
Sight Distance Ratio	7.2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	3.66 (wt.avg)	64	x	0.149	=	9.54
Info. System Deficiencies	3.5 (wt.avg)	59	x	0.115	=	6.79
		Sums:		1.000	=	56.17

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00034 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 56.17 + 0.25 x 100

P.I. = 67.1

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 8 Date April 16, 1979

Site Description McGirl Rd. east of U.S. 312

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33 acc/yr	40	x	0.164	=	6.56
Accident Rate	1.88 acc/MEV	31	x	0.225	=	6.98
Accident Severity	9,614 dollars	58	x	0.191	=	11.08
Volume/Capacity Ratio	0.15	33	x	0.082	=	2.71
Sight Distance Ratio	Z 2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	1.0 (wt.avg)	17	x	0.149	=	2.53
Info. System Deficiencies	4.0 (wt.avg)	74	x	0.115	=	8.51
		Sums:		1.000	=	38.37

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 9 Date April 16, 1979

Site Description Intersection of Piccolo Lane and Old Hardin Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.164	=	4.26
Accident Rate	0.55 acc/MEV	10	x	0.225	=	2.25
Accident Severity	13,433 dollars	68	x	0.191	=	12.99
Volume/Capacity Ratio	0.143	32	x	0.082	=	2.62
Sight Distance Ratio	Z_2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	0.75 (wt.avg)	15	x	0.149	=	2.24
Info. System Deficiencies	0.5 (wt.avg)	9	x	0.115	=	1.04
		Sums:		1.000	=	25.40

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{--}{}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 10 Date April 16, 1979

Site Description Intersection of Lockwood Rd. and Refinery Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	0.67 acc/yr	21	x	0.164	=	3.44
Accident Rate	2.3 acc/MEV	37	x	0.225	=	8.33
Accident Severity	9,800 dollars	59	x	0.191	=	11.27
Volume/Capacity Ratio	0.031	14	x	0.082	=	1.15
Sight Distance Ratio	0.9 (wt.avg)	38.8	x	0.074	=	2.87
Driver Expectancy	1.0 (wt.avg)	18	x	0.149		2,68
Info. System Deficiencies	0.8 (wt.avg)	18	x	0.115	=	2.07
		Sums:		1.000	=	31.81

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 11 Date 4/16/79

Site Description Intersection of Bench Blvd. and Wicks Lane

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0 acc/yr	51	x	0.164	=	8.36
Accident Rate	1.49 acc/MEV	25	x	0.225	=	5.63
Accident Severity	3,783 dollars	41	x	0.191	=	7.83
Volume/Capacity Ratio	0.1785	35	x	0.082	=	2.87
Sight Distance Ratio	Z 2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	2.0 (wt.avg)	36	x	0.149	=	5.36
Info. System Deficiencies	0.8 (wt.avg)	17	x	0.115	=	1.96
		Sums:		1.000	=	32.01

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 12 Date April 16, 1979

Site Description Curve on Rd. to City Dump just west of Blue Creek Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.164	=	5.25
Accident Rate	2.3 acc/MEV	37	x	0.225	=	8.33
Accident Severity	14,200 dollars	69	x	0.191	=	13.18
Volume/Capacity Ratio	0.085	24	x	0.082	=	1.97
Sight Distance Ratio	0.6 (wt.avg)	95	x	0.074	=	7.03
Driver Expectancy	3.0 (wt.avg)	52	x	0.149	=	7.75
Info. System Deficiencies	1.66 (wt.avg)	31	x	0.115	=	3.57
		Sums:		1.000	=	47.08

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = --$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00112 $/vehicle

Cost Factor: 97

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 47.08 + 0.25 x 97

P.I. = 59.6

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 13 Date April 16, 1979

Site Description Intersection of Greenwood Ave. and Old Hardin Rd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.33 acc/yr	32	x	0.164	=	5.25
Accident Rate	0.68 acc/MEV	12	x	0.225	=	2.70
Accident Severity	6,450 dollars	49	x	0.191	=	9.36
Volume/Capacity Ratio	0.136	31	x	0.082	=	2.54
Sight Distance Ratio	1.25 (wt.avg)	20	x	0.074	=	1.48
Driver Expectancy	0.5 (wt.avg)	9	x	0.149	=	1.34
Info. System Deficiencies	0.75 (wt.avg)	15	x	0.115	=	1.73
		Sums:		1.000	=	24.40

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: -- $/vehicle

Cost Factor: --

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x _____ + 0.25 x _____

P.I. = N/A

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 14 Date April 16, 1979

Site Description Garden Ave. South of 27th Street

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.67 acc/yr	34	x	0.164	=	5.58
Accident Rate	4.25 acc/MEV	60	x	0.225	=	13.50
Accident Severity	11,280 dollars	62	x	0.191	=	11.84
Volume/Capacity Ratio	0.048	18	x	0.082	=	1.48
Sight Distance Ratio	1.0 (wt.avg)	28	x	0.074	=	2.07
Driver Expectancy	2.5 (wt.avg)	45	x	0.149	=	6.71
Info. System Deficiencies	1.66 (wt.avg)	31	x	0.115	=	3.57
		Sums:		1.000	=	44.75

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00018 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 44.75 + 0.25 x 100

P.I. = 58.6

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 15 Date April 16, 1979

Site Description Yellowstone River Rd. - first curve east of Bench Blvd. and above Coulsen Park

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	0.67 acc/yr	21	x	0.164	=	3.44
Accident Rate	1.10 acc/MEV	20	x	0.225	=	4.50
Accident Severity	12,400 dollars	65	x	0.191	=	12.42
Volume/Capacity Ratio	0.074	22	x	0.082	=	1.80
Sight Distance Ratio	1.25 (wt.avg)	21.3	x	0.074	=	1.58
Driver Expectancy	2.66 (wt.avg)	45	x	0.149	=	6.71
Info. System Deficiencies	2.0 (wt.avg)	43	x	0.115	=	4.95
		Sums:		1.000	=	35.40

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.015 $/vehicle

Cost Factor: 71

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 35.40 + 0.25 x 71

P.I. = 44.3

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 16 Date April 16, 1979

Site Description 3rd St. in Worden from 100' south of RR track to 100' north of Lewis Ave.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	8.67 acc/yr	73	x	0.164	=	11.97
Accident Rate	15.43 acc/MEV	100	x	0.225	=	22.50
Accident Severity	3,212 dollars	38	x	0.191	=	7.26
Volume/Capacity Ratio	0.070	22	x	0.082	=	1.80
Sight Distance Ratio	72 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	3.66 (wt.avg)	64	x	0.149	=	9.54
Info. System Deficiencies	3.33 (wt.avg)	61	x	0.115	=	7.02
		Sums:		1.000	=	60.09

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00031 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 60.09 + 0.25 x 100

P.I. = 70.1

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 17 Date April 16, 1979

Site Description 32nd St. W. just north of King Ave.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.164	=	4.26
Accident Rate	4.13 acc/MEV	59	x	0.225	=	13.28
Accident Severity	6,600 dollars	50	x	0.191	=	9.55
Volume/Capacity Ratio	0.03	14	x	0.082	=	1.15
Sight Distance Ratio	$\geq$ 2 (wt.avg)	0	x	0.074	=	0
Driver Expectancy	2.0 (wt.avg)	29	x	0.149	=	4.32
Info. System Deficiencies	2.0 (wt.avg)	36	x	0.115	=	4.14
		Sums:		1.000	=	36.70

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00004 $/vehicle

Cost Factor: 100

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 36.70 + 0.25 x 100

P.I. = 52.5

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 18 Date April 16, 1979

Site Description Intersection of Lake Elmo Rd. and Pemberton Lane

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.0 acc/yr	26	x	0.164	=	4.26
Accident Rate	8.85 acc/MEV	95	x	0.225	=	21.38
Accident Severity	9,367 dollars	57	x	0.191	=	10.89
Volume/Capacity Ratio	0.014	7	x	0.082	=	0.57
Sight Distance Ratio	1.0 (wt.avg)	37	x	0.074	=	2.74
Driver Expectancy	2.5 (wt.avg)	44	x	0.149	=	6.56
Info. System Deficiencies	1.66 (wt.avg)	29	x	0.115	=	3.34
		Sums:		1.000	=	49.74

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{--} =$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00095 $/vehicle

Cost Factor: 97

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 49.74 + 0.25 x 97

P.I. = 61.6

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 19 Date April 16, 1979

Site Description Intersection of Conway St. and Yellowstone River Rd. with Bench Blvd.

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.33 acc/yr	40	x	0.164	=	6.56
Accident Rate	1.70 acc/MEV	28	x	0.225	=	6.30
Accident Severity	3,643 dollars	40	x	0.191	=	7.64
Volume/Capacity Ratio	0.054	19	x	0.082	=	1.56
Sight Distance Ratio	0.8 (wt.avg)	54	x	0.074	=	4.00
Driver Expectancy	3.0 (wt.avg)	53	x	0.149	=	7.90
Info. System Deficiencies	1.0 (wt.avg)	22	x	0.115	=	2.53
		Sums:		1.000	=	36.49

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.00615 $/vehicle

Cost Factor: 88

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 36.49 + 0.25 x 88

P.I. = 49.4

PRELIMINARY EVALUATION

YELLOWSTONE COUNTY, MONTANA
DETERMINATION OF PRIORITY INDEX

Site Number 20 Date April 16, 1979

Site Description Yellowstone River Rd. "S" curve by County Nursing Home

HAZARD INDEX (H.I.)

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	1.67 acc/yr	34	x	0.164	=	5.58
Accident Rate	3.76 acc/MEV	57	x	0.225	=	12.83
Accident Severity	8,160 dollars	54	x	0.191	=	10.31
Volume/Capacity Ratio	0.12	29	x	0.082	=	2.38
Sight Distance Ratio	1.25 (wt.avg)	20	x	0.074	=	1.48
Driver Expectancy	2.66 (wt.avg)	45	x	0.149	=	6.71
Info. System Deficiencies	2.5 (wt.avg)	45	x	0.115	=	5.18
		Sums:		1.000	=	44.47

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{--}{} = \frac{}{--}$$

Relative Strength of Evaluation:

Sum of Applicable Weights x 100 = 100 %

*Do not include weights for indicators not used at this site.

COST FACTOR (C.F.)

Data Value: 0.024 $/vehicle

Cost Factor: 54

PRIORITY INDEX (P.I.)

P.I. = 0.75 x (H.I.) + 0.25 x (C.F.)

= 0.75 x 44.47 + 0.25 x 54

P.I. = 46.9